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Annual Report

To the Congress

Fiscal Year 1987

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Section I.—Statements by the Chairman and Vice Chairman of the Board, TAAC Chairman, and the Director of OTA

CHAIRMAN'S STATEMENT— CONGRESSMAN MORRIS K. UDALL

It is now fifteen years since the Technology Assessment Act was passed, establishing the Office of Technology Assessment. Those of us appointed initially to the Technology Assessment Board knew that we would have to devote a lot of time to this brand new agency. We were all acutely aware that prior to 1972, Congress had never tried to operate a bicameral, bipartisan office. OTA was an experiment, balanced between Houses, between parties, with a dedication to strict neutrality, technical and analytical excellence, and responsiveness to all important points of view.

Fifteen years later, I take great satisfaction in the fact that OTA is widely recognized as filling its special niche in the legislative process with distinction. Over at least a decade, OTA has kept Congress aware of new developments in technology and the implications for policy. Year after year this congressional agency has contributed objective insightful analysis of highly controversial subjects. Both sides used OTA analysis in the 1977 coal-slurry pipeline debate in the Interior Committee. Since then OTA has helped define the legislative debate for such controversial issues as the use of animals in research, health care reimbursement, nuclear waste disposal, MX missile basing, acid rain, effects of Agent Orange, and implications of biotechnology.

In the past several years, the Board has stuck to its strictly bipartisan mandate, yet enabled OTA to tackle for Committees such highly charged subjects as seismic verification of nuclear tests, and human infertility (including in vitro fertilization). I am proud to chair this body, whose members are committed to defend OTA's mission of bipartisan analysis even when their individual political interests may not be directly served. OTA now provides Congress and the American people with a well-reasoned sense of technology and policy. In the words of C.P. Snow: "A sense of the future is behind all good politics. Unless we have it, we can give nothing—either wise or decent—to the world."

VICE CHAIRMAN'S STATEMENT—SENATOR TED STEVENS

When I joined the Technology Assessment Board (TAB) more than thirteen years ago, the Technology Assessment Act was about two years old and OTA had been underway as an agency less than a year. All of us on the Board lived through a lot of worry and hard work, sometimes trying to meet as often as once a week to oversee, guide, and support the newly assembled staff of this fledgling agency. We struggled to keep OTA from being consumed in the preparation of short-term analyses arising out of the constant crises that Congress must endure, and at the same time tried to avoid frittering away the agency's resources on long-range prognostications that would have had little or no practical policy consequences.

About ten years ago, OTA began to focus on assessing the critical issues of technology for Congress. In subject after subject OTA looked ahead at opportunities and problems posed by new and existing technology and outlined the practical policy options for Members of Congress and others. OTA has succeeded in doing this in a remarkably bipartisan way, especially considering the controversial nature of the bulk of the issues it is asked to address. OTA's products are now widely accepted as world-class in analytical quality and they are often directly helpful in focusing and resolving policy debates.

On the occasion of its 15th Anniversary it is well worth noting OTA has achieved the skills and maturity to work constructively on the most controversial and difficult scientific issues. As funding continues to be scarce for studies and assessments of the social and economic impact of emerging technologies on our country, the non-partisan commitment that Congress has made to OTA is more cost-effective than ever.

TAAC CHAIRMAN'S STATEMENT—
WILLIAM J. PERRY

A decade ago when OTA was only five years old it was not yet clear whether this brand new agency could really develop a successful method of helping society assess the full impact of new technologies while there was still time to shape their impact. At 1977-78 House hearings on the Technology Assessment Act, one of my predecessors as chairman of TAAC, Jerome Wiesner, testified that OTA had performed a number of useful studies, but the promise of the agency to help the United States anticipate the problems and opportunities caused by technology, had not yet been realized.

As chairman of TAAC a decade later, I am reassured that OTA indeed has developed an effective, useful process of technology assessment. Over the last four or five years, especially, OTA has explored one major area of technology after another. It made, for example, the first comprehensive review and analysis of the promise and pitfalls of commercial biotechnology. This year, OTA will publish a series of closer looks at particular issues in biotechnology; one of the most significant of these will be a study on the release of bio-engineered organisms into the environment.

OTA has also done thorough and impressive work alerting Congress to forthcoming issues in such diverse areas as electronic monitoring of workers, the capacity of the U.S. service industries to remain competitive, and the promise of new materials such as polymers and composites. In the forthcoming months the debate on arms control initiatives and a new configuration of forces in Europe will be enriched by two important OTA studies—one on new technologies for NATO which outlines the options for implementing conventional follow-on force attack capability (FOFA) forces, and the other, soon to be released, on seismic verification of nuclear tests.

In these studies OTA has in fact done what a decade ago Jerome Wiesner only hoped they would—they have alerted the Congress and American society to opportunities presented by new technologies as well as warned of potential pitfalls.

DIRECTOR'S STATEMENT—JOHN H. GIBBONS

PART I

One hundred forty-five years ago there was discussion about closing the U.S. patent office because all major inventions and discoveries were behind us. Developments in science and technology in 1987 suggest that Lewis Thomas' claim—that the greatest discovery of this century is the discovery of the extent of human ignorance—is more accurate. To extend that thought, we've learned that many things earlier thought to lie beyond human understanding are knowable. The current flood of discovery, across all dimensions of size and space, is awesome!

Dickens' description of 19th Century conditions . . . "it was the best of times, it was the worst of times"—holds true today. In 1987 one could have entitled a weekly journal "The Best of Times," because major advances in science were achieved in high-temperature superconductivity, cosmology, molecular and cellular biology, and other fields. It is from those advances that we will derive many new options for dealing with the physical wants, needs, and cares of people. It is also from such discoveries that we expand human thought and appreciation of the creation of which we are a part. Also during 1987 a signal event for humankind—de-escalation of the nuclear arms race—marked a new direction for United States and the Soviet Union. This achievement was made possible in large part, by the extraordinary capabilities of satellite reconnaissance technology.

Yet other events in 1987 reminded us that these may also be the worst of times. Discovery of mutant forms of the retrovirus that causes AIDS dashed already dim hopes for a ubiquitous tech-fix in treating AIDS victims. Significant loss of high altitude ozone, (the shield against cancer-causing ultra-violet solar radiation) shows how technology employed for human good (for example, air conditioning, refrigeration, insulation) can impose destructive side-effects. We are again and again reminded that, *like political liberty, the price of technological liberty is eternal vigilance of its unwanted impacts.*

Our open approach to research, trade, and international development, has been so successful that a host of other nations are rapidly catching up with us. We find beneficial and harmful influences of science and technology deeply embedded in our personal, national, and global lives. They affect governance to a degree barely imagined in the past. Extraordinary demands are made of those in school preparing for the responsibilities of citizenship as well as upon those citizens charged with governance. OTA holds the sobering responsibility of helping citizens understand the events of science and the technological challenges and options before us.

PART II

OTA happily remains a small agency working on big problems. We're the smallest of the congressional agencies, and Lilliputians compared to most executive branch agencies. That's not to say that we're too little, or that the other organizations are too big, but to illustrate the point that a small group of people, with broad access to information and wisdom inside and outside government, can play a pivotal role in government. In 1987 OTA directly helped more than 30 full Committees of the House and Senate to grapple with the several dozen key issues of technology. We also continue to be gratified that many other people in government, industry, and academia make frequent use of OTA's products.

OTA's job is neither the saving nor the spending of public money, nor is it advocating or denegrating a given technology; rather it is to help create and sustain informed judgment on the part of decisionmakers, and help elevate citizen awareness of both the promises and problems of technology. In particular, we continue to be gratified by the willingness of busy experts thoughout the public and private sectors to assist OTA in its work. Without that help the agency would best serve the nation by closing down.

PART III

The year 1987 marked the 15th year of OTA's existence. Now 15 isn't a terribly significant number—it's not even prime—but it is noteworthy for two reasons. First, many of the founders of OTA felt that the agency, in exploring new methods of analysis, public involvement, and bipartisan work for committees, would require a decade or more of testing before its value or even its legitimacy could be judged. Thus this anniversary became a constructive time for OTA to look back, evaluate, and refocus our efforts on productively shaping our future directions. Second, 1987 marked the Bicentennial of the U.S. Constitution, which heightened our desire to reexamine our role, however small, in democratic governance.

As I view it, OTA epitomizes the opportunity in a democratic society for political leaders to foster broad and meaningful participation of stakeholders in issue analysis. OTA's process helps focus the issues to be resolved and identify areas of consensus and potential resolution. This activity forms a critical complement to the direct and necessarily polarized positions stakeholders must assume when taking their separate cases directly to the political leaders. Over the course of the analysis in many of our studies we have observed that actions taken and positions modified by stakeholders and relevant Federal agencies have led to near-term resolution of the issues.

OTA usually focuses its energies on issues that Congress is or soon will be working on. In all instances we try to address longer term consequences of nearer-term decisions. For example, a recent OTA paper, *Science, Technology and the Constitution,* presented the opportunity to speculate about the likely interplay of developments in technology and constitutional governance in the coming decades. Despite its brevity, this paper (first in a series) was featured in several leading technical journals.

We are a nation committed to discovery and invention as much as we are to democracy and freedom. Indeed, these ideas are intimately related. With that philosophy, we must expect that *change* is inherent, however discomforting and traumatic as it may sometimes be. The central role for OTA must remain that of anticipating, interpreting, explaining, and helping shape and accommodate change in the best interests of the people—present and future.

Section II.—Year in Review

The assessments carried out by OTA cover a wide spectrum of major issues that Congress and the country are facing. A brief summary of each report published by the Office during the year* is presented in this section. The reader is cautioned that these are synopses of reports. They do not cover the full range of options considered or all of the findings presented in any individual report.

Integrated Renewable Resource Management for U.S. Insular Areas

Integrated Renewable Resource Management for U.S. Insular Areas

Agriculture, aquaculture, fisheries, and tourism are the likely keys to economic vitality on many of the nearly 2,300 U.S.-affiliated Caribbean and Pacific islands. Many past attempts to develop these resources, however, have not provided long-term support for the islands' growing populations, but rather, reduced resource productivity and the number of options for future development.

Needed is an approach that integrates various natural systems to allow their sustained resource development without degrading or depleting them.

High levels of financial aid from the United States during the last two decades have not fostered modern, self-reliant island economies, as was intended. Most of these islands have become increasingly dependent on Federal funding for jobs, public welfare, and imports of food and other goods and services.

With the possible exception of Puerto Rico, all of the islands are small in land area and in population. The Micronesian islands are distributed over an area as large as the United States (excluding Alaska and Hawaii) but only have an aggregate land area no greater than two-thirds that of Rhode Island.

The U.S.-affiliated Pacific and Caribbean islands are the only U.S. tropical islands. Their histories include colonization by other nations which primarily exploited island resources, and periods of strategic importance to the United States. Most U.S. tropical islands today remain of strategic interest, and are viewed as the United States' third and fourth borders.

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*Fiscal year 1986 (October 1, 1986 to September 30, 1987).

Integrated management of renewable resources for sustained or improved yields requires a blend of strategies for resource development, conservation, recovery, and replenishment. Although the effort can be costly over the short term, expenses can be minimized by developing, using and recycling local inputs, and by relying on local peoples to provide planning information and to enforce conservation measures. Also, programs and projects need to be compatible with local cultures and customs for success in long-run policies.

A development approach that acts in concert with island natural processes will have fewer adverse environmental impacts and may lower production costs. Past resource degradation on many islands has damaged the natural systems that buffer erosion from heavy tropical rainfall, freshwater runoff, and waves. The results have been increasing loss of resources and development options.

Many islands are capable of sustaining high agricultural and aquatic productivity. Potential exists for increasing the productivity of agricultural methods and for introducing new crops and agricultural technologies. Mangrove, seagrass, and coral-reef ecosystems are particularly productive, and together support populations of economically valuable marine organisms. Certain insular natural resources also may contribute to island development through tourism.

Approaches to agriculture or fisheries development can be tailored to nonmarket, semicommercial or fully commercial production as required. Appropriate technologies range from container cropping in castoff oil drums on remote atolls to highly-mechanized hydroponic systems for culture of high-value crops near urban markets. Similarly, while nearshore natural fisheries offer little room for increased harvest, applicable aquaculture systems range from low-maintenance marine enclosures to intensively managed hatcheries and raceways. Resource development planning technologies certainly could help to identify which technologies are most suitable for individual circumstances.

Improved use of food preservation and processing technologies, marketing and transportation services need increased consideration in the making of agricultural development policies.

Integrating resource management with other forms of economic development also can be a way to reap "double-duty" from investments. However, little advantage has been taken of these opportunities. For example, livestock farms can generate some of their own energy. Agriculture and aquaculture technologies can support each other when combined into a single system. Infrastructure such as roads or airport runways also can serve as passive water catchments.

Although development priorities and efforts of insular governments are of primary importance to pursuing economic opportunities, especially in the Freely Associated States, Congress can assist in a variety of ways:

- by tuning appropriate Federal agencies and programs to the islands' special situations and needs;

- by coordinating the work of agencies responsible for various aspects of island resource management;
- by making opportunities for Federal assistance directed at developing sustainable resource use readily apparent and more easily available to the islands; and
- by providing additional assistance in renewable resource data collection, and associated management, planning, education, extension, training and research.

The U.S.-affiliated Caribbean islands include Puerto Rico and the U.S. Virgin Islands (USVI). U.S.-affiliated Pacific islands are American Samoa, and the Micronesian islands of Guam, the Commonwealth of the Northern Mariana Islands (CNMI), the Republic of the Marshall Islands (RMI), the Federated States of Micronesia (FSM), and Republic of Palau. The FSM and RMI recently have signed compacts with the United States to become Freely Associated States. Puerto Rico and, as of late 1986, the CNMI are U.S. commonwealths. American Samoa, Guam, and the USVI are unincorporated territories.

The Border War on Drugs

Despite a doubling of Federal expenditures on drug interdiction over the past 5 years, illegal imports of cocaine, the drug now of intense national concern, have almost doubled since 1981, supplying a growing number of users at prices that have fallen as the supply has increased.

THE
BORDER
WAR
ON
DRUGS

The challenge faced by drug enforcement agencies is formidable. The large market, coupled with the huge profits to be made by transporting drugs from foreign suppliers to domestic wholesalers, fuels this illegal traffic. OTA estimates that the mark-up between foreign and domestic wholesale prices is on the order of 20 to 30 times for marijuana, 4 to 5 for cocaine, and 30 to 40 for heroin. In 1985, the value added to these drugs through smuggling alone was roughly $6 billion for marijuana, $1.6 billion for cocaine, and $1 billion for heroin. Of this, perhaps 90 percent (over $7 billion) was realized as profit by drug smugglers.

Drug Transport Modes

The drug traffic moves by a variety of transport modes and routes to reach the United States. Most imported marijuana comes either by sea, in private vessels, or by land, across the Mexican border, but private aircraft and commercial transport are also used. Cocaine is smuggled across all coasts and the Mexican border, with about half the traffic carried in private aircraft and a large share of the remainder in private ships or boats. The amount of cocaine smuggled through ports of entry appears to be increasing. The heroin produced in Southeast and Southwest Asia comes through ports of entry primarily carried by airline passengers or hidden in cargo or mail. The amount of Mexican heroin that enters across the land border is increasing.

Smugglers show great ingenuity in devising methods of entry. When interdiction efforts restrict a particular mode of transport or route, drug traffickers quickly shift to alternatives. As a result, the Nation's long and highly permeable borders are being assaulted by an illegal traffic that uses all conceivable means of transport and concealment.

Federal Interdiction Efforts

The agencies with primary responsibility for drug interdiction are the Customs Service, the Coast Guard, and the Border Patrol of the Immigration and Naturalization Service. These front-line agencies, supported by numerous other Federal agencies, have seized increasing quantities of drugs over the past 5 years. In fiscal year 1986, almost $800 million was expended by the Federal Government in this effort, and the number and quantity of seizures was higher than ever before. Despite these efforts, the impact on drug trafficking has been slight, and the flow of drugs into this country has not been stemmed. Only a small percentage of drugs are being seized.

The Anti-Drug Abuse Act of 1986 (Public Law 99-570) affirms the legislative intent to continue interdiction as a major element in drug law enforcement. The Act authorizes a substantial increase in funding for interdiction and greater use of military assets. It also sets the stage to resolve some of the fragmentation in organization and responsibilities for drug interdiction. It provides mechanisms for allocating new military equipment and requires legislative proposals from the President by mid-1987 to reorganize executive branch efforts to combat drug trafficking and abuse.

The goal of the Nation's overall anti-drug abuse program is to reduce the number of users and prevent others from becoming users. The national strategy includes reducing both supply and demand. Interdiction is only one element of supply reduction, which also includes investigation and prosecution, and international narcotics control. While many debate the relative merits of each of these elements, most agree that some level of effort in each is necessary. The total effort to combat drug abuse is also always tempered by such concerns as its impact on civil liberties or on legitimate commerce and other private activities.

Central to the success of future drug interdiction efforts are the technologies employed to detect, intercept, and capture smugglers. This study investigates the availability, use, and performance of the technologies now used and those that could contribute to the Nation's effort to prevent illegal drug traffic. This involves not only examination of the technology itself but also of the organizations that use these systems and the enforcement strategies they employ.

Findings

There is no clear correlation between the level of expenditures or effort devoted to interdiction and the long-term availability of illegally imported drugs in the domestic market. Given the profitability of drug smuggling, a worldwide glut of drugs, and the view that the United States is the favored market for drugs, interdiction alone will probably never result in more than a short-term or relatively small reduction in drug availability.

The value of intelligence is very high for all aspects of drug interdiction. In particular, good tactical intelligence can mean a large increase in ability to identify smuggling attempts. In certain areas, intelligence gathering is limited by inadequate resources and an ineffective network. Needed information cannot be gathered and delivered to the users in a timely fashion. Classified intelligence, even if valuable to interdiction efforts, is not often or easily used because of concerns about revealing sources and methods during court proceedings.

Over the past 2 years many new technologies, ranging from remote sensors to pursuit aircraft and patrol boats, have been introduced into Federal drug interdiction programs. These technologies have, for the most part, enhanced Federal capabilities. However, the technologies are just now becoming operational and evaluations of their overall effectiveness cannot be made without more experience and a directed effort to collect relevant data for evaluation.

No single technology has been identified that would solve the Nation's overall drug interdiction problem. But there are many opportunities for individual technologies to make incremental contributions to specific Federal interdiction efforts. Realizing these opportunities may require development of new technologies or procurement of increased numbers of existing technologies. However, most technological improvements, by themselves, may have only a temporary benefit because the drug traffickers will take rapid and usually successful actions to neutralize the effectiveness of new interdiction techniques.

Responsibilities of the Federal drug interdiction agencies are fragmented and overlapping. The lack of a suitable institutional framework is a major impediment to the adoption and effective use of technologies—particularly command and control systems that could offer significant benefits. With the exception of special intensive operations, problems with interagency coordination and cooperation occur and no central authority addresses important strategic questions on priorities and resource allocation.

Interdiction Goals

Even though goals for the national drug interdiction program are seldom stated explicitly, it appears that three major objectives make up the implicit working goals of all of the agencies involved. These are:

1. to constantly harass and deter all significant smuggling attempts, and to work toward disrupting the trafficking networks, seizing as many drugs as possible and making arrests of the drug traffickers;
2. to force the most vulnerable drug trafficking organizations out of business; and
3. to demonstrate a national resolve to curtail the drug use and abuse problem.

Options

This OTA assessment of interdiction technologies suggests a range of options that could be employed by the Federal agencies in an effort to improve the effectiveness of future operations, increase success within their operational strategies, and make more efficient use of resources. These options are:

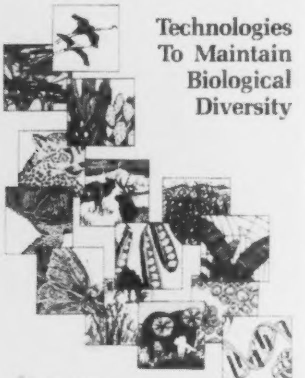
Preparation of a coordinated, long-range plan for use of interdiction resources and technologies. Such a plan would match resources to the present threat and develop a system to assure that consistent monitoring of trafficking is fed into the planning process. The plan could include networks for intelligence and surveillance data as well as designated commands to apply pressure at appropriate major smuggling modes of port of entry, air, marine, and land borders.

Establishment of a common system to evaluate deterrent capabilities and the effectiveness of technologies and techniques used for interdiction. The system would need to include specific data to be collected, standards for measuring detection rates and apprehension rates, consistent costing methods, and procedures for using the most appropriate data to evaluate systems or operations.

Development of a substantial research and development (R&D) program to develop more effective detection technologies for ports of entry. There is some promise of technological advancement in this area but R&D efforts are too small to conduct needed work. Existing National laboratories may be available to provide the technical base for this R&D effort.

Design and development of a border surveillance network for smuggler traffic. Sufficient technologies (mostly military) are available to design the network, but a design for their use is still lacking.

Technologies To Maintain Biological Diversity



The Earth's biological diversity is being seriously reduced, and the losses are likely to accelerate over the next several decades. The most optimistic view of the consequences of reduced biological diversity is that resources that otherwise might improve the quality of human life will not be available. At worst, reductions could mean a serious disruption of the ecological processes on which civilization depends. To avert such adverse consequences, the United States needs to strengthen its commitment to global conservation efforts.

In the past, diversity among ecosystems, species, and genes was maintained without specific conservation efforts. But as natural areas continue to be disrupted by human activities, maintaining biological diversity increasingly depends on the development and use of specific conservation measures. Of particular concern are those highly diverse ecosystems such as moist tropical forests, coral reefs, and Mediterranean type environments, with high numbers of unique species.

Two complementary approaches are necessary to conserve biological diversity. One approach, called "onsite maintenance," is to maintain parks and other natural areas to preserve plants and animals in the areas where they occur naturally. The other approach, called "offsite maintenance," is to preserve diversity apart from natural habitats in places such as seed banks or zoos. Onsite maintenance is the best means of maintaining a broad range of biological diversity in the long term. Offsite maintenance is the most economical method for preserving a small but critical component of genetic diversity such as the thousands of plant varieties important to agriculture. As threats to biological diversity increase, greater interaction between the two approaches will be required.

Maintaining global biological diversity will require greater coordination of conservation efforts by the United States and other countries. Several government and private programs in the United States and elsewhere address narrow conservation objectives such as protecting migratory species or genetic resources of importance to agriculture. Generally, these programs are uncoordinated, underfunded, and too narrow to address the biological diversity issue effectively. Furthermore, the ad hoc conservation programs that currently exist do not cover the broad scope of areas that are important to maintaining biological diversity.

To improve knowledge about the extent and rate of loss that is occurring, more emphasis should be placed on the collection of additional data. One of the challenges for the U.S. Congress and other policymakers is to strike a balance between using resources to collect better data on rates of loss and analyze likely consequences on the one hand, and implementing specific conservation efforts to meet known threats on the other.

The ability to maintain diversity will increasingly depend on the availability of useful, affordable technologies and on programs designed to apply these technologies to a broader range of species or ecosystem types. At present, technologies and programs to conserve or enhance biological diversity are limited in their application. The application of science to conservation is a relatively recent event, and a formal discipline in this area is only just emerging. Further progress will depend on promoting and encouraging institutions and researchers to place greater emphasis both on the synthesis of research results and on technology development and transfer in support of resource managers.

Losing A Million Minds: Confronting the Tragedy of Alzheimer's Disease and Other Dementias

Dementia—the loss of mental functions as a result of an underlying brain disorder—is emerging as an enormously costly problem in America.

LOSING A MILLION MINDS
Confronting the Tragedy of Alzheimer's Disease and Other Dementias

Alzheimer's disease accounts for two-thirds of all dementia. There is no cure, no means of prevention and no fully effective treatment for this disorder. Many patients suffering from Alzheimer's disease and other dementias eventually become dependent and require long-term care at home or in institutions.

As more Americans live to be over 65, the number of victims of this age-related disorder is expected to grow rapidly. Currently, nearly 1.5 million Americans suffer from severe dementia, and another 1 to 5 million have mild or moderate cases.

By the year 2000, the number of victims of severe dementia is expected to increase by 60 percent. Unless a cure is found, well over 7 million Americans will suffer from severe dementia caused by Alzheimer's disease and other disorders by 2040—a five-fold increase from today.

Estimates about the financing of care—including costs of diagnosis, treatment, nursing home care, informal care, and lost wages—for those with Alzheimer's disease and other dementing disorders range from $24 to $48 billion each year. As America's population ages, these costs and related social ramifications are expected to increase dramatically.

Trends

The U.S. population over the age of 65 is growing rapidly and living longer. This significantly increases the number of people at risk of developing dementia. The prevalence of severe dementia rises from about

1 percent for those age 65 to 74, to 7 percent for those 75 to 84, to 25 percent for those 85 and older.

Treatments for dementia alleviate symptoms rather than cure the disease. Currently, there is no cure for Alzheimer's disease and most other dementing conditions. Treatment focuses on changing the environment and training the family and other caregivers to meet the needs of patients. Medications are usually used to control behavioral symptoms rather than to restore lost mental functions.

Dependence on government and formal services is likely to increase as the role of the family as a primary source of support weakens. Most patients are cared for at home by family members until physical and emotional resources are exhausted. But a number of demographic and social trends suggest that future families will be unable to provide care at home:

- Those most at risk of developing dementia are in their 80s, and children and spouses of these individuals are also likely to be older and at risk of disability.
- Declining fertility rates are reducing the number of those available to care for tomorrow's older people.
- Most caregivers are middle-aged daughters, but as women increasingly join the work force, they are less available as caregivers.
- Rising divorce and remarriage rates are complicating the issue of who gives care to older relatives.
- Increasing family mobility leads to geographic dispersion and loss of family caregivers.

The increasing number of patients with dementia often cannot get medical, mental health, and social services from sources outside their families. Social service programs are typically intended for target populations, and those with dementia may not qualify. Many programs for the aged often exclude the mentally impaired and are not helpful to those with dementia. Programs that address social rather than medical needs usually are not covered by government health programs or standard health insurance. And the kind of coordination between medical and social services necessary for patients with dementia is unavailable in most public or private systems.

An increasing number of dementia patients and their families are finding the enormous burden of care unbearable. These patients and families seek either outside assistance or nursing home placement. Medicare, Medicaid and private insurance are often inadequate, because:

- Most private insurance does not cover long-term care.
- Federal and State coverage of long-term care is being reduced as part of the effort to contain public health costs.
- Medicare reimbursement is limited to short-term, acute-care home and nursing home coverage, yet most patients with dementia need primarily personal care, supervision, and care that lasts for years.
- Medicaid pays the cost of institutional care only for the indigent, and the range and quality of care vary widely from State to State

and within States. To qualify for Medicaid, many patients with dementia and their families must impoverish themselves by "spending down" to eligibility.

Policy Questions

Public response to the increasing challenge of dementia requires answers to specific policy questions.

Should there be special programs for those afflicted with dementia? There has been a proliferation of nursing home care, special day care centers, board and care facilities, and hospitals solely for patients with dementia. Advocates of special care argue that patients with dementia need specially trained caregivers and that such units can improve patients' lives, but critics contend that such facilities could become repositories for neglected patients.

Should special entitlements to existing programs be available to patients with dementia? Such entitlements would make service eligibility contingent on a particular diagnosis or type of disability. A special Medicare or Medicare entitlement for dementia could be created, similar to the Medicare eligibility for end-stage renal disease. But special entitlement would place an unrealistic demand on accurate diagnosis. It also would promote competition rather than cooperation between groups plagued by different diseases.

Should there be more research into the causes, treatment, and cure for dementia? Research on dementia is in its infancy, and most experts agree more information is needed before public policies, medical practices, and use of services can be rationally assessed. Federal funding for research on dementia has increased from less than $4 million in 1976 to a projected $67 million in 1987, but remains four to five times lower per patient than for cancer or heart disease.

What kind of training should caregivers receive and who should pay for it? Quality services for patients with dementia presume the availability of trained people to deliver these services. Yet most of those caring for patients with dementia have never been trained to do so. For example, 80 to 90 percent of the personal contact with patients in long-term care facilities is provided by nursing aides who have little education, low pay, and a high chance of shifting jobs quickly.

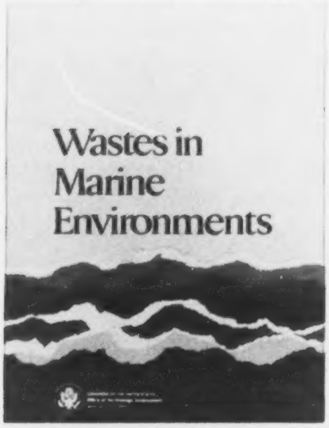
Policy Options

Because there is no cure, no means of prevention, and no fully effective treatment for patients with Alzheimer's disease and most other dementing disorders, government strategies for solving this growing public health problem are currently limited to two areas: 1) support of research in hope of discovering a cure or means of prevention, and 2) delivery or coordination of services for patients and their families. In these two areas, medical and policy experts have suggested that the Federal Government could reduce the growing problem of dementia, including Alzheimer's disease, with:

- support for basic and clinical research,
- support for health services research,
- financing of long-term care,
- education and training of those providing care,
- aid for patient assessment and coordination of existing services,
- broadened scope and range of services available to patients and families, and
- assurance of quality care.

Wastes in Marine Environments

Trends in Marine Waters



"Where can we dispose of our wastes?" Every community and industry in the country faces this question. For years, the Nation's marine environments have provided an answer for coastal communities and industries.

Estuaries and coastal waters, in particular, bear the brunt of marine waste disposal activities, and many are in deep trouble around the Nation. Among disposal activities, industrial and municipal pipeline discharges are at least as important as dumping in causing damages; urban and agricultural runoff, although not classed as disposal activities, also are very important. High levels of organic chemicals, metals, and pathogens are found in many estuaries and coastal waters, along with excess nutrients and low oxygen levels. Reported human illness from eating contaminated shellfish or swimming in contaminated waters is rising. Commercial harvests from about one-third of productive shellfish areas are now prohibited or partially restricted because of contamination.

In contrast, the open ocean exhibits few adverse impacts from waste disposal—partly because relatively few wastes have been disposed of there and partly because it can widely disperse most wastes. However, more research is needed to determine whether toxic pollutants present in these wastes will cause long-term damages.

Management Efforts

Pollutant control programs under the Clean Water Act and dumping criteria and permitting procedures under the Marine Protection, Research, and Sanctuaries Act regulate discharges and dumping. These programs and procedures have helped reduce the amounts of pollutants entering marine waters. As implemented, however, they have not protected some estuaries and coastal waters from degradation. Moreover, even with total compliance, which is unlikely, existing regulations will not be sufficient to maintain or improve the health of all estuaries and coastal waters.

To address the continuing degradation of certain estuaries and coastal waters, the Federal Government and the States have established some individual "waterbody management" programs (e.g., Chesapeake Bay Program, Puget Sound Water Quality Authority). And, in the 1987 Water Quality Act, Congress named additional waterbodies for possible management action. This site-specific approach is very promising.

However, State and/or Federal programs still do not exist for most estuaries and coastal waters. A critical link is missing—a systematic framework for deciding when and how to provide additional, site-specific management for estuaries and coastal waters. Developing such a framework to supplement current programs is now appropriate. It could be based on the water quality approach embodied in the Clean Water Act. This approach has not been generally applied to estuaries and coastal waters.

For the open ocean, the permitting system has been successful so far: industrial waste dumping has declined dramatically, and sewage sludge and dredged material dumping is now relatively well-controlled. Given the open ocean's enormous dispersive nature, relatively uncontaminated sewage sludge and dredged material probably can be dumped without causing significant adverse impacts. Some uncontaminated wastes also can be used beneficially on land in certain situations.

Policy Options

OTA concludes that actions from a two-tiered set of options could help to maintain or improve the health of the Nation's estuaries and coastal waters and to assess their role in waste management.

First, continue to implement present pollutant control programs and possibly enhance their scope. This could involve:

- improving enforcement;
- ensuring adequate funding of municipal treatment plant construction by some combination of Federal, State, and local investments;
- regulating additional pollutants and sources; and
- applying ocean discharge criteria to estuaries.

Second, provide additional waterbody management to address site-specific problems, where needed. A systematic framework to provide such management, based on a water quality approach, would involve:

- establishing site-specific goals and evaluating progress;
- identifying those waterbodies needing additional management; and
- developing management plans and deciding whether a national program to coordinate such development is necessary.

Open ocean policies could go in either of two directions: toward maintaining or strengthening restrictions on open ocean disposal; or toward easing them to allow increased disposal of some wastes. Deciding which policy to choose depends on factors such as the availability of waste management options on land. Disposal options on land are becoming more limited, however, especially for dredged material and to a lesser extent for sewage sludge. If estuaries and coastal waters receive greater protection, pressure to increase open ocean disposal will probably intensify.

In addition to this report, OTA addressed other marine waste disposal issues in its report on *Ocean Incineration: Its Role in Managing Hazardous Waste* and its staff paper on *Subseabed Disposal of High-Level Radioactive Waste.*

Major Findings

- The vast majority of pollutants entering marine waters goes into estuaries and coastal waters.
- Many estuaries and some coastal waters will continue to degrade or begin to do so during the next few decades unless additional protective measures are taken.
- The health of the open ocean appears to be better than that of estuaries and coastal waters.
- Industrial and municipal pipeline discharges, as well as runoff, are at least as damaging to valuable marine resources as is dumping.

Pressure for Marine Waste Disposal

The pressure to use marine waters for disposal will increase for many reasons, including:

- the proximity of marine waters to major or growing urban areas that generate large amounts of wastes;
- the desire for waste disposal to occur far away from one's neighborhood or city;
- the frequently lower costs of marine disposal;
- limits on the economic feasibility of land-based disposal for high-volume wastes such as dredged material; and
- limits on land-based disposal of sewage sludge and dredged material because of public opposition and State or local regulatory restrictions.

Pollutant Sources

Pollutants enter marine waters around the country every day in a variety of ways, including waste disposal and runoff. Most of these major sources are regulated under the Clean Water Act and the Marine Protection, Research, and Sanctuaries Act:

- 1,300 major industrial and almost 600 municipal facilities discharge wastewater directly into estuaries and coastal waters;
- thousands of industrial and municipal facilities discharge into rivers that eventually flow into estuaries;
- about 180 million metric tons of dredged material are dumped annually in marine waters, mostly in estuaries;
- about 7 million metric tons of sewage sludge are dumped annually, now mostly in coastal waters but soon only in the open ocean; and
- agricultural and/or urban runoff affect virtually all estuaries and coastal waters.

New Technology for NATO: Implementing Follow-On Forces Attack

NATO's Supreme Allied Commander Europe, General Bernard W. Rogers, has warned that if the Warsaw Pact were to attack NATO, it would only be a few days before he would have to ask NATO's political leaders for permission to use nuclear weapons. Furthermore, there is a danger that NATO's conventional defenses could be overrun so rapidly that NATO would not have time to use the nuclear weapons it has in Europe. General Rogers and others have been pushing to improve NATO's conventional defenses so that the credibility of NATO's deterrent is maintained. If current negotiations between the United States and the Soviet Union result in drastic reductions in medium and intermediate range nuclear weapons in Europe, the burden on NATO's conventional forces would increase, and the importance of improving them would be amplified.

NATO has always relied on technological superiority to help compensate for major disadvantages it has had relative to the Warsaw Pact. But in recent years, the forces of the Warsaw Pact—particularly those of the Soviet Union—have become significantly more technologically sophisticated, leading NATO to search for other means to redress the balance.

One of the solutions has been the adoption of the Follow-On Forces Attack, or FOFA, concept. FOFA exploits emerging technology to counter a specific aspect of Soviet strategy—the use of follow-on ground forces to continue the work of the initial attackers. NATO's forces would use long-range weapons to attack the follow-on forces before they could reach NATO's troops. FOFA is applicable throughout NATO Europe, but is primarily focused on the Central Region, where West Germany borders East Germany and Czechoslovakia.

Initially, FOFA was a contentious issue within the Alliance. It was formally adopted in late 1984, and by early 1987 the controversy had subsided, but not ended. Serious questions still remain regarding the role of FOFA within NATO's Flexible Response strategy, what is actually to be done by the members of the Alliance to implement FOFA, and whether the technology will really perform as advertised. In addition, FOFA has stimulated thinking about how to produce the next generation of technologically sophisticated weapons, and the future of armament developments within NATO.

The Technical Controversy

FOFA relies both on sophisticated sensor systems to look deep into enemy territory and find targets and on modern weapons that can hit and kill those targets, including armored vehicles. While the technology for both these applications is well into development, many of the systems have yet to be demonstrated. Strong doubts remain about how well they will work under realistic combat situations, and about whether the ultimate performance will justify the cost. There are concerns about the performance of many sophisticated systems in the presence of countermeasures, the survivability of important airplanes, and overall performance if several sophisticated systems are used together.

The Military Controversy

The U.S. Army and Air Force are strong believers in the value of FOFA, termed "deep battle" by the Army and "interdiction" by the Air Force. Our European Allies have also endorsed it. Reservations over how it should be done and how much emphasis it should be given remain on both sides of the Atlantic, particularly in Europe. There are differences concerning how deep to strike, what kinds of targets to attack, what to strike with, what priority to give FOFA within NATO's warfighting missions, and whether it is better to attack massively or selectively. Over the past few years there has been significant movement toward consensus, accompanied by modification of the FOFA concept to fit individual national views.

The Political Controversy

NATO's deterrent strategy presents the Warsaw Pact with the prospect that any attack could escalate to an unacceptable nuclear conflict. Some Europeans fear that FOFA and other conventional force improvements could weaken deterrence by making NATO's conventional forces too strong, leading the Warsaw Pact leadership to think that NATO would keep a conflict conventional and not escalate to nuclear weapons. Furthermore, some Europeans argue that FOFA is aggressive, destabilizing, and not in keeping with NATO's posture as a defensive alliance.

Procurement issues—what will be needed to implement FOFA, who will produce it, and how it will be paid for—have assumed major importance within the Alliance. FOFA arrived on the scene concurrently with a number of U.S. equipment developments. This led many Europeans to view FOFA as a U.S.-inspired plan to sell U.S. equipment. But the Europeans are unlikely to simply buy many U.S. systems, preferring codevelopment programs that stimulate European technology development as well as American.

Findings

- Most of the systems needed for an effective FOFA capability either exist or are in various stages—mostly the latter stages—of development. However, not all the technical problems have been solved, including that of making combinations of complex systems work together reliably.
- To have an effective capability, complete packages of systems must be procured in sufficient quantities to support specific operational concepts.

- FOFA is a reasonable response to Soviet strategy, but it would be unwise to treat that strategy as rigid or not capable of evolution. There will always be follow-on forces, but their importance may well change.
- The Soviets are reconsidering their military thinking taking FOFA into account, considering building similar systems, and attempting to exploit European reservations regarding FOFA.
- FOFA has evolved from a contentious issue within NATO to quiet negotiations among armaments experts. The Central Region Allies have agreed to develop and procure systems to support FOFA out to about 150 kilometers, but they disagree about which parts of the 150 kilometers to emphasize, and the schedule for procuring the capability.
- NATO's current capability to attack follow-on forces is quite limited.
- The key to producing the needed systems is likely to be multinational cooperative ventures, particularly codevelopment ventures. Our European Allies have an active interest in cooperative programs, and are interested in U.S. participation. But they are unlikely to be enthusiastic about programs that do not stimulate their technology development. They are unhappy about U.S. restrictions on transferring defense-related technology.
- Several outstanding issues, shown below, remain to be resolved.

Outstanding Issues

- **The Joint Surveillance Target Attack Radar System (Joint STARS):** This program to develop an airborne system to locate moving vehicles deep within enemy territory has been contentious within Congress over the past several years. While most interested military parties believe its capabilities are very important for FOFA, some believe that it will be too vulnerable to attack.
- **The Aquila Remotely Piloted Vehicle:** This RPV system, or another like it, could be very valuable to the Army for targeting artillery, the new multiple launch rocket system, and the developmental ATACMS ballistic missile. But the program is over budget and behind schedule.
- **A Successor to the Precision Location Strike System (PLSS):** PLSS was supposed to provide a much-needed capability to target enemy air defenses and other systems. But technical problems and cost escalation led the Air Force to reduce funding drastically. A decision is needed on whether to resurrect PLSS, begin a replacement program, or drop the idea.
- **Smart Anti-Armor Submunitions:** Attacking moving combat vehicles will depend on producing weapons that are capable of destroying many vehicles per shot. The technology is mature, but some technical problems remain to be solved.
- **Armaments Cooperation:** As the Europeans rely more on cooperative programs to fill their defense needs, the United States will have to decide how deeply it is willing to get involved in such programs.

International Competition in Services: Banking, Building, Software, Know-How . . .

U.S. manufacturing industries and U.S. service industries are tightly linked and depend on one another, domestically and internationally. They will prosper together or fall behind together. Both will benefit from Federal policies that help them adapt to change. Both would also benefit from an international trade regime that permits the synergies between domestic and foreign production, goods and services, American know-how and foreign know-how, to multiply. Maintaining U.S. living standards—and maintaining national security—will demand a long series of difficult policy decisions.

INTERNATIONAL
COMPETITION
IN SERVICES
BANKING
BUILDING
SOFTWARE
KNOW-HOW

A competitive array of service industries leads to jobs and exports in many sectors of the economy, including manufacturing—one reason the United States has made reductions in barriers affecting services trade a major issue in the Uruguay Round trade negotiations. For example, U.S. engineering and construction firms specify U.S. capital goods in the petrochemical plants they design and build. Foreign subsidiaries of American banks help finance the overseas business activities of American manufacturing companies.

Exports of manufactured goods lead, likewise, to exports of services; for instance, contracts for training and maintenance follow from sales of commercial aircraft. More subtly, U.S.-based multinationals seeking new opportunities on a world scale need an infrastructure that can support globally integrated business activities—a support system that includes not only banking, but telecommunications services, advertising, insurance, and the host of other concomitants of international business.

But U.S. competitiveness in the services could be threatened just as it has been in manufacturing. As in many manufacturing industries, the primary challenge is coming from Japan. Already, Japanese firms have a major worldwide presence in services as different as banking and construction.

U.S. domestic policies affect the international competitive position of American service industries, but awareness of these impacts remains low among the two dozen or more relevant Federal agencies and bodies. Many of these bodies—for instance, those with regulatory or supervisory authority over financial institutions—take little account of the international ramifications of their actions. With the Nation's economy increasingly linked to the world economy, public policies must change to reflect these realities. If they do not, the Nation's competitiveness in services may slide as it has in manufacturing. If this happens, the U.S. standard of living will fall even faster than it has so far.

Four Services

OTA examined banking, engineering and construction, information technology services, and technical licensing (a source of revenues for manufacturing firms almost exclusively) in some detail, in order to understand the forces shaping trade and competition in services and the role of public policies.

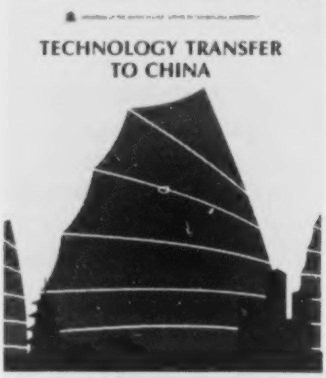
Banking and Financial Services.—International banking has grown at explosive rates, fueled by deregulation and new products such as currency and interest rate swaps—many of these new products possible only because of developments in computer and communications technologies. American banks have done well in the rapidly changing environment of the past 10 to 15 years. Only the Japanese have mounted a major competitive challenge. Given the speed of change in banking, U.S. policymakers and regulators will have to take greater account of the impacts of their decisions on the international competitiveness of the Nation's banking industry.

Engineering and Construction (E&C).—While international banking has been growing, the international E&C market has been shrinking. Today, foreign contractors often have technology as good as—in some cases, better than—American firms. The competitive future for the U.S. E&C industry resembles that of the Nation's smokestack manufacturing industries. Moreover, inability to compete abroad may foreshadow inability to compete at home. Better utilization of existing technologies and aggressive development of new technical know-how could help American E&C firms improve their competitive ability. Federal policies that provided support for new strategic thrusts by the U.S. E&C industry—thrusts based on regaining a technological edge—could contribute to renewed competitiveness.

Information Technology Services.—American companies remain world leaders in all the services based on information technologies. But the Japanese will become more competitive in computer software—vital throughout high-technology economies—if only because their rapid progress in hardware will force them to improve their software. Moreover, better software in Japan will lead to major productivity increases **throughout** Japan's economy. Telecommunications is equally vital for a broad range of U.S. industries. Because of this, Federal agencies with domestic and/or international responsibilities over telecommunications will have to make impacts on U.S. competitiveness a normal and routine, rather than extraordinary, element in policymaking.

Technical Licensing.—For years, the United States has been a source of technology for the rest of the world. Today, with foreign technology often as good as American know-how, the United States can also learn from the rest of the world. Federal policies that encourage inflows of foreign technology could help support the long-term competitiveness of many U.S. industries. A broad range of symptoms also indicate that the vast base of technology underlying the Nation's commercial industries—particularly those well removed from defense needs—no longer adequately supports an economy as large and diverse as that of the United States. OTA's analysis suggests a real need for overhauling the Nation's technology policy.

Technology Transfer to China



Supplying technology to China can lead to significant U.S. commercial benefits, strengthen political ties, and reinforce China's reformist trends and movement toward a more constructive international role. However, at least in the near-term, commercial benefits are likely to be smaller than had been hoped a few years ago. Technology transfer poses political and commercial risks as well as benefits, but they are almost all in the long term.

Most technology transfer from the United States is undertaken by companies in the form of licensing arrangements, training and information that accompanies sales of equipment, and investments in China, such as joint ventures. In addition, U.S. Government agencies transfer technology through scientific and technical cooperation. Technology transfer also occurs via scholarly exchanges and the education of Chinese students in American universities.

Commercial Prospects

China cannot meet its goals of rapidly modernizing its industry and upgrading its technical sophistication without large-scale importation of technology. Since China's economic growth for the remainder of the century is likely to be rapid, there will be many opportunities for sales of U.S. goods and services. Technology transfer is often a requirement for access to China's marketplace. U.S. companies have several advantages in competing for this market, including a reputation in China for advanced technology, connections through Chinese-Americans, and the popularity of the English language in China. However, several liabilities seem to keep U.S. exports below what might be expected: limited export experience and drive; rigid export controls; very limited U.S. Government promotion and financing; and, until recently, an overvalued dollar.

One of the largest obstacles to accelerated technology transfer is the difficult and uncertain climate in China for foreign business operations, especially for long-term investments. Some improvements have been made, but many problems remain. Further progress is likely to depend on political reforms, which will probably be delayed by the recent instabilities in the political hierarchy.

China's impressive technological capabilities in a few areas, such as rockets and nuclear weapons, are not representative of its economy as a whole. Most civilian industries are still far behind world standards, though some are modernizing rapidly. New technology is needed to permit the manufacture of higher quality and more sophisticated products, and to alleviate constraints such as energy shortages and infrastructure inadequacies. The most visible impact of technology transfer is likely to be on the quality of Chinese products, many of which are now too poorly designed and produced to be competitive in Western markets.

China's increasing role in the international economy should be beneficial to the United States, but the impact will be uneven across industries. The U.S. textile industry is finding China to be a strong competitor, while the aircraft, computer, and petroleum industries, among others, have developed constructive relationships. China's main competition in developing exports will be the newly industrialized countries. One of China's major purposes for increasing exports is to pay for increasing imports of technology. The success of this strategy, and the impact on the United States, will depend on the degree to which other developed countries open their markets to Chinese products.

Strategic Issues

China's military as well as economic capabilities will be increased by transferred technology, even if most technologies are not imported explicitly for military purposes. For instance, powerful computers can be used advantageously for nuclear weapons design as well as for oil exploration analysis. However, military systems of the sort that might threaten the United States must be designed with expertise in many different disciplines and skillfully constructed under stringent quality control. China's difficulties in assimilating advanced technologies suggest that most dual-use technologies will be of limited near-term use in developing sophisticated weapon systems. Dual-use technology is more likely to be of use in improving the conventional weapons that China exports in great quantity.

Military capabilities could be improved faster through purchases of weapon systems than by adaptation of dual-use technologies, but China does not see a security problem pressing enough to lead it to spend much foreign exchange on weapons. In the long-term, growing expertise in the commercial sectors, stimulated in part by technology transfer, will provide the base for rapid growth in military capabilities. But China will not approach the military strength of the superpowers for several decades.

China's main strategic concern is likely to remain the Soviet Union. China could be a threat to its smaller neighbors, some of whom have close ties to the United States. However, many factors affect the balance of power in Asia, and technology transfer has operated more as an inducement for China to work for stability in the region than as a contributor to the growth of Chinese military power.

Policy

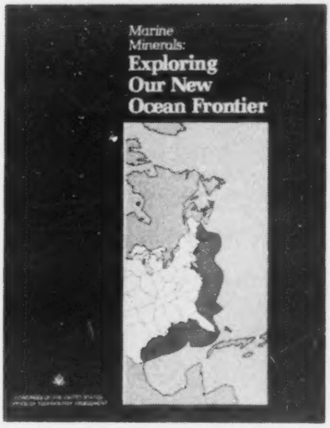
Over the past decade, U.S. policy toward China has been based on the proposition that China's modernization is consistent with U.S. interests. As relations with China have warmed, U.S. export controls have been loosened considerably; however, there is still room for improvement in the implementation of this policy.

"Green zone" applications—for exports of technology or equipment meeting certain criteria—are being processed more quickly than in past years (though apparently still slowly when compared with other countries). However, export license applications involving advanced technologies that the Department of Commerce must refer to other agencies, such as the Department of Defense, still encounter long delays. In January 1987, licenses for 800 million dollars' worth of exports had been in the DOC system awaiting a decision for over 60 days and 145 million dollars' worth had been in for over 12 months. Congress may wish to consider improvements in the efficiency and transparency of the interagency review process. Better mechanisms for removing less sensitive items from the controlled list and better definition of the remaining items could also be useful.

OTA did not find evidence to substantiate U.S. industry's complaints that other members of COCOM (the Western nation organization that reviews exports to Communist countries) willfully circumvent multilateral export rules. However, other countries may interpret the rules less rigidly and license exports of equipment that U.S. companies could not export.

The U.S. Government does little compared to Japan and Europe to promote exports. The United States is unlikely to match the concessional financing offered by some countries, but expansion of other activities—such as support for feasibility studies, technical training, sectoral trade promotion, and expanded official financing—could assist U.S. exporters. Exports to China are a test case for U.S. competitiveness in Asia and initiatives affecting trade with China must be seen in the overall context of U.S. policy on trade, in addition to their impact on international relations.

Marine Minerals: Exploring Our New Ocean Frontier



Since the 1983 Presidential proclamation creating the U.S. Exclusive Economic Zone (EEZ), the Congress, the executive agencies, and industry have asked: Can the Nation benefit from seabed mining in its newly established domain? This ocean zone around the U.S. coastline is a "new frontier" requiring considerable exploration to answer that question definitively.

The ocean has slowly begun to yield its secrets over the last several decades. The knowledge gained has enabled scientists to revise their theories about the formation of some types of seabed mineral deposits and to better predict where new deposits might be found. However, only the sketchiest picture exists about the type, quality, and distribution of seabed minerals that someday may be exploitable.

Minerals in the U.S. EEZ

Although only a fraction of the U.S. EEZ has actually been explored for minerals, several types of mineral deposits are known to occur in various regions. These include sand and gravel; heavy mineral sands that contain titanium, chromium, gold, possibly platinum, and other minerals; metallic crusts and nodules containing cobalt and manganese; and sulfide deposits of copper, zinc, and associated minerals. At the current stage of preliminary resource assessment in the EEZ, little credence should be given to existing estimates of the economic value or tonnages of seabed minerals.

The marine minerals with the greatest future potential for development are the high-value, low-volume precious metals such as gold and platinum and, if located near high demand areas, low-value, high-volume sand and gravel. Mining of gold offshore Nome, Alaska began in 1987. Sand and gravel are currently being dredged on a small scale at the entrance to New York Harbor as an additional source of supply for the New York market. Worldwide, dredging technology has been used to recover tin, diamonds, shells, carbonates, and sand and gravel at several locations.

Findings

With two possible exceptions (i.e., sand and gravel and precious metals), the commercial prospects for developing marine minerals within the Exclusive Economic Zone appear to be remote for the foreseeable future. Marine minerals cannot now compete for price, quality, and reliability of supply with other foreign and domestic mineral suppliers.

Because of the economic uncertainties and financial risks of EEZ mining, it is doubtful that the private sector will undertake substantial exploration in the EEZ until the government provides preliminary information about the location and extent of marine minerals.

The immediate challenge to the United States is to gain a better understanding of the physiography and geology of the seafloor and its environment and to inventory mineral occurrences within U.S. jurisdiction. The possible strategic importance of several minerals in the seabed—e.g., cobalt, chromium, manganese, and the platinum-group metals—could make future economic considerations secondary to national security concerns.

The Outer Continental Shelf Lands Act has limited applicability for managing hard minerals. Congress is currently considering EEZ mining legislation aimed at remedying shortcomings in this Act. Until suitable mining legislation exists, there is little prospect that industry will substantially invest in expensive minerals exploration.

More than 10 Federal agencies share responsibility for EEZ minerals exploration. It is important that these agencies coordinate their complementary and overlapping functions.

Many technologies for exploring the seabed are available and in use. These range from reconnaissance technologies that provide relatively coarse, general information about very large areas to site-specific technologies that provide information about increasingly smaller areas of the seafloor.

Dredge technology for mining unconsolidated material in nearshore, shallow, protected water can be readily adapted from the various types of dredges now working in harbors and channels. Mining dredges working in deeper water subject to winds, waves, swell, and currents will need to be specially designed. Technology for mining cobalt-rich crusts and polymetallic sulfides has not yet been developed.

Little direct experience exists with commercial offshore mining with which to estimate the potential for environmental harm. However, anticipating and avoiding high-risk, sensitive areas and mitigating unavoidable damage through improved equipment design and operating procedures can probably reduce environmental impacts.

Options

Exploring the Nation's new ocean frontier will require a long-term government commitment because of the enormity of the undertaking. Among the issues that need to be addressed are:

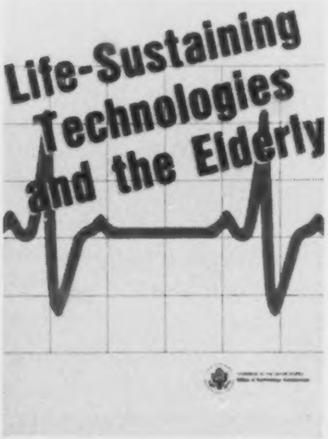
1. **Focusing the national exploration effort.** Laws requiring agency coordination and planning to address similar problems in Arctic research, acid precipitation, and marine pollution are possible prototypes.
2. **Providing an administrative framework for future seabed mining.** Several alternatives exist: enacting new legislation for exploring and developing EEZ minerals; amending Section 8(k) of the Outer Continental Shelf Lands Act or adding a new title to it, applicable only to marine hard minerals; or using the authority of the

Minerals Management Service to develop a regulatory system under Section 8(k).

3. **Improving the use and management of the Nation's EEZ data and information.** Timely and systematic transmittal of oceanographic data to national data centers is needed. Congress may have to provide explicit direction to Federal agencies for this to occur. National data centers may also need additional funds to upgrade data services for meeting future needs.
4. **Assisting the States in preparing for seabed mining.** Since the first major U.S. efforts to commercially exploit marine minerals are likely to occur in territorial waters under the jurisdiction of coastal States, the Federal Government could assist States by providing technical assistance. For example, the National Oceanic and Atmospheric Administration's Office of Ocean and Coastal Resource Management or the Department of the Interior's Minerals Management Service could be directed to assist the States to formulate their own marine minerals legislation. Alternatively, provisions for State assistance could be written into new marine mining legislation or into amendments to the Outer Continental Shelf Lands Act, or Congress could rely on the initiatives of individual coastal States to formulate marine minerals legislation.
5. **Providing for limited public use of classified oceanographic data.** This issue might be addressed by establishing regional classified data centers, by conducting a thorough congressional review of the Navy's classification policies and procedures, or by allowing the National Oceanic and Atmospheric Administration and the Navy to continue to seek a solution to the problem on their own.

Life-Sustaining Technologies and the Elderly

Dramatic advances in medical technologies give new hope for life to people with conditions that only a few years ago would have meant certain death. As use of the technologies has expanded, however, so has concern about inappropriate use for some patients who do not benefit and for whom suffering may be prolonged. Questions have also been raised about whether patients are sufficiently involved in treatment decisions. The growing emphasis on limiting health care costs has led to concern that expensive life-sustaining technologies may be withheld from patients who would benefit. OTA's report addresses these concerns with respect to elderly people, but some findings are also relevant to younger people.



The report focuses on five life-sustaining technologies: 1) cardiopulmonary resuscitation (CPR), 2) mechanical ventilation, 3) renal dialysis, 4) tube and intravenous feeding and hydration, and 5) antibiotic therapy for life-threatening infections.

More than half of all patients who receive CPR and tube feeding and about one-third of patients who receive mechanical ventilation, dialysis, and TPN (an intravenous feeding procedure) are over age 65.

Life-sustaining treatments are expensive. In 1985, the cost of mechanical ventilation for a hospitalized patient (including the cost of hospitalization) averaged about $850 a day, and TPN averaged $196 a day (not including the cost of hospitalization). For patients at home, the technologies can cost $12,000 to $200,000 a year. The cost of the technologies is sometimes only a small part of the cost of caring for severely debilitated patients whose lives they have extended.

Outcomes

It is often assumed that elderly people will not do well on these technologies, and some people believe that expensive life-sustaining technologies are wasted on elderly patients. In fact, mortality is high for people of all ages who receive the technologies, but outcome is difficult to predict in individual cases.

Elderly patients are statistically more likely than younger adults to die or to develop serious complications of treatment. Age is a poor predictor of outcome in individual patients, however. The best predictor of outcome is a patient's physiological status—particularly whether he or she suffers from multiple acute or chronic conditions. Elderly people vary more in physiological status than any other age group, and many elderly people who receive life-sustaining technologies do as well or better than younger patients.

Except for antibiotic therapy, the technologies OTA studied do not cure disease, and some patients are permanently technology dependent. Patients' quality of life varies, depending on their physical and mental status, and other factors. People weigh the relative benefits and burdens of treatment differently, however, and what is an acceptable quality of life to one individual may not be acceptable to another.

Rationing life-sustaining technologies on the basis of age would clearly result in the deaths of many people who could survive with a quality of life that is acceptable to them. Research on factors that affect outcome is needed to assist patients, families, physicians, other health professionals in making treatment decisions.

Access

Medicare's prospective payment system for hospital care, instituted in 1983, creates strong financial incentives for hospitals to reduce their costs for treating Medicare patients. OTA has found no specific evidence that this system has limited access to life-sustaining technologies for elderly patients in hospitals. Health professionals continue to warn of this possibility, however, and congressional oversight may be warranted.

Cost-containment strategies in hospitals have increased demand for care outside the hospital. Yet few nursing homes have adequately trained staff (or financial incentives to develop staff) to provide complex life-sustaining technologies.

Outside a hospital, Medicare does not cover antibiotics and pays only 80 percent of the cost of mechanical ventilation, dialysis, tube feeding, and TPN. In some cases, coverage in a hospital is so much more complete that persons who could safely go home remain in the hospital, sometimes indefinitely.

Decisionmaking

Decisions about life-sustaining technologies for some patients—notably those who are terminally ill, severely debilitated, or permanently unconscious—raise difficult clinical, legal, and ethical dilemmas. In hospitals and nursing homes, many people are involved in caring for the patient. These individuals have different values, beliefs, and experiences with the technologies, and different perceptions of the patient's treatment preferences. Such differences can lead to intense disagreement about appropriate treatment. Decisions about tube or intravenous feeding and hydration engender the most controversy.

There is a strong presumption in favor of using each of the technologies OTA studied for patients of all ages with life-threatening conditions. Anecdotal evidence suggests, however, that older patients are less likely than younger patients to receive them.

Patients may be unable to participate in decisions about life-sustaining technologies because they are too ill, too confused, or unconscious when the decision must be made. Even patients who are able to participate may not be involved. This may be the patient's preference. However, physicians and others sometimes assume wrongly that older patients are not able to participate. There are no agreed upon procedures for determining decisionmaking capacity, and better methods are needed.

Adults who are decisionally capable have a legal right to refuse any unwanted medical treatment, and in specified circumstances, life-sustaining treatments can be legally withheld or withdrawn from adults who are not decisionally capable. There is disagreement and uncertainty, however, about decisionmaking procedures that ensure patient autonomy and at the same time protect vulnerable patients from harmful decisions.

Informed consent is frequently not obtained for the technologies OTA studied, either because the situation is an emergency (e.g., CPR and mechanical ventilation) or because the treatments are considered ordinary and noninvasive (e.g., antiobiotic therapy and nasogastric tube feeding). For critically ill and severely debilitated patients, use of these technologies usually requires a series of decisions, and practical approaches to obtaining informed consent for such patients are needed.

In everyday medical practice, health professionals usually turn to a patient's family for assistance with treatment decisions, but in most States there is no legal authority for family members to make such decisions.

Advance directives—living wills and durable powers of attorney—allow individuals to express their preferences about the use of life-sustaining technologies and to designate someone to make treatment decisions for them if they become decisionally incapable. Few people have executed an advance directive, though.

A living will takes effect only when a patient is diagnosed as terminally ill, and many States do not allow withholding or withdrawal of tube feeding on the basis of a living will. A durable power of attorney may be a more flexible method for individuals to ensure that their wishes are known. The best method may be a combination of the two.

Many hospitals and some nursing homes have institutional ethics committees to assist with difficult treatment decisions. In addition, some have formal policies that define the rights and responsibilities of the patient, the family, physicians, nurses, and others in the decisionmaking process, and procedures for making and recording the decisions. Most such policies only address decisions about CPR. Institutional policies for decisions about other technologies are also needed.

Quality of Care

Technological developments that improve the reliability, safety, portability, and comfort of life-sustaining technologies and decrease their cost would improve quality of care for patients of all ages. In addition, modification of some equipment and/or procedures to reflect age-related changes in physiological functioning would improve the outcome of treatment. Such adjustments are seldom made, however, because of unanswered questions about the physiology of aging and because of the shortage of health professionals trained in geriatrics.

Little is known about treatment options for patients who cannot or choose not to receive life-sustaining technologies. Greater knowledge and wider availability of palliative care options would improve the care of patients for whom sustaining life is no longer the goal.

The Electronic Supervisor: New Technology, New Tensions

The Electronic Supervisor

New Technology

New Tensions

Digital telephone systems, computerized work stations, and other electronic technologies are beginning to provide powerful new tools for employers to monitor employees and their activities both in and outside of the workplace. An important future issue will be to ensure a fair balance between employers' rights to improve efficiency, productivity and security in their facilities, and workers' rights to prevent overly intrusive surveillance and data collection.

Work monitoring is an old practice, and Federal policy has, by and large, left the balancing between employer and employee to private bargaining. However, because new surveillance technologies—including biological testing as well as electronic monitoring—are potentially so powerful and intrusive, Congress is beginning to be asked to intervene legislatively. Such technologies include:

- **Computer-based** or **electronic work monitoring** systems automatically record statistics about the work of employees who use computer or telecommunications equipment, for example, numbers of keystrokes or types of transactions made.
- **Service observation** refers to listening in on an employee's conversation with a customer to check on factors such as courtesy or accuracy, and can be done in conjunction with computer-based systems.
- **Telephone call accounting** refers to automatic, computer-generated records of the time, duration, and destination of calls, and is generally used by employers to reduce the number of personal calls rather than to supervise work. Equipment and software for telephone call accounting make up the fastest growing segment of the telecommunication industry.
- **Worker testing** examples include polygraph testing, drug testing, genetic screening, and brain wave testing.

Computer-based work monitoring affects a small but growing segment of the work force (estimated at 6 million) as computers are introduced into a greater variety of workplaces. Because the monitored activities are primarily public ones, issues of privacy infringement in the legal sense generally do not surface. However, some workers have expressed a feeling of invasion of privacy when they are "constantly watched" by a machine. Also, questions may arise in connection with employees' ability to see or challenge their work records.

The central issues raised by electronic work monitoring relate to fairness. Such monitoring appears most likely to be opposed or resented by employees when it is imposed without their understanding and participation or when work standards are perceived as unfair.

An additional issue, which requires further study, is the possible effect of computer-based work monitoring on employee health. Some data suggest that electronic monitoring of the quantity or speed of work contributes to stress and stress-related illness. However, research has not yet separated the effects of such monitoring from those of poor job or equipment design, bad lighting, and other potentially stressful aspects of work with electronic office technologies.

Workers and labor organizations have argued that **service observation** contributes to stress and creates an atmosphere of distrust. However, the practice is legal when a part of a formally established procedure of evaluation.

Telephone call accounting can be a powerful tool for managing the costs of telephone systems, but privacy questions arise when the resulting records are used to track calling habits of individuals. The ongoing development of a new Federal Government telephone system adds to the need for policies for using these technologies and for protecting such records against misuse.

Worker testing clearly raises questions about fairness and privacy. Fairness questions relate to the accuracy of the tests as well as to the criteria for deciding who is to be tested. Privacy issues include employers' acquisition of personal information not related to work, and the protection of records generated by testing.

Nothing in U.S. law requires that monitoring be "fair" or jobs be well-designed, except as addressed in union contracts, which cover less than 20 percent of the work force. Neither does anything in U.S. law specifically protect workers against stress, although stress can be a compensable injury under Workman's Compensation statues. Even where unions are involved, labor contracts have generally given considerable latitude in making use of new monitoring technologies to employers.

A major question for Congress is whether ensuring a reasonable balance between workers' and employers' rights is a matter for labor/management negotiation or for congressional action. And it is important to note that policy action taken with respect to a particular form of monitoring will not necessarily prevent controversies that arise as new forms of technology are introduced into the workplace.

SPECIAL REPORTS

The Social Security Administration and Information Technology

In this special report, OTA examines the objectives and technical strategies embodied by the Social Security Administration in its Systems Modernization Plan and the progress that the Social Security Administration has made toward its implementation. The report calls attention to some general problems faced by both SSA and other Federal agencies that are increasingly dependent on communications and information technology in carrying out their missions.

New Developments in Biotechnology: Ownership of Human Tissues and Cells

In this special report, OTA analyzes the economic, legal, and ethical rights of the human sources of tissues and cells and also those of the physicians or researchers who obtain and develop these biological materials. The study describes the potential of three rapidly moving technologies (tissue and cell culture, cell fusion to produce monoclonal antibodies, and recombinant DNA) for manipulating human tissues and cells to yield commercially valuable products. The report includes a range of options for congressional action related to commercialization of human biological materials, regulation of research with human subjects, and disclosure of physicians' commercial interest in patient treatment. This report is the first in a series of OTA studies being carried out under an assessment of "New Developments in Biotechnology."

The U.S. Textile and Apparel Industry: A Revolution in Progress

This special report examines the textile and apparel industries as they exist today, their structure, and the forces of change already at work. The report also addresses trade, technology, employment, and marketing issues along with a review of policy options and the barriers that must be overcome to achieve effective change.

Trade Adjustment Assistance: New Ideas for an Old Program

This special report analyzes the strengths and weaknesses of TAA in helping trade-affected workers find or train for new jobs. TAA's greatest strength is its capacity to support long-term training. Its major weaknesses are delays in delivery of services and lack of attention to workers' individual needs. This report focuses especially on coordinating TAA benefits with the services available to all displaced workers under Title III of the Job Training Partnership Act, in ways that take advantage of the strong points of both programs and best serve the individual worker.

From Pollution To Prevention: A Progress Report on Waste Reduction

Public interest in protecting health and environment by preventing the generation of hazardous wastes and environmental pollutants is rising. Some companies are discovering that prevention is easier than they thought and that its economic benefits come quickly.

This report examines the effectiveness of the limited Federal actions taken so far and summarizes what industry and State and local governments have done to implement waste reduction. These programs are encouraging, and they help us understand what congressional policy options might accomplish. This special report discusses in greater detail several options that first appeared in *Serious Reduction of Hazardous Waste.*

U.S. Oil Production: The Effect of Low Oil Prices

This special report presents the results of OTA's analyses of a group of factors believed to strongly influence the future direction of U.S. oil production. These factors include the expected profitability of new investments in drilling, the potential of new oil exploration, development, and production technologies, the nature of the remaining oil resource base, and structural changes in the oil industry. The special report also provides a brief discussion of some policy options for Congress to consider if it decides to moderate the expected accelerated decline in U.S. oil production.

TECHNICAL MEMORANDA

A Review of U.S. Competitiveness in Agricultural Trade

America's ability to compete in international agricultural markets has come into question during the past several years. Several factors have contributed to recent declines in the volume and value of U.S. agricultural exports. The global recession of the early 1980s, along with expanded production among the major exporting nations, accentuated competition for world markets. Many countries, especially those in the developing world, began to develop sophisticated domestic production capacities, and cut back on imports wherever possible. Technology transfer from the United States has become increasingly rapid.

Technology-Dependent Children: Hospital v. Home Care

Recent advances in medical technology have permitted sick children who once would have died to survive with the assistance of sophisticated equipment and intensive nursing care. Often, the assistance is needed for just a short time, but sometimes the dependence on life-sustaining technology is permanent. As technology for helping keep children alive has improved, a new population of technology-dependent children has emerged.

This technical memorandum provides a working definition of technology dependence and estimates the prevalence of technology dependence among American children. OTA has also found that the cost-saving potential of home care depends to a great extent on attributes of the family and the home environment.

Commercial Newsgathering From Space

The news media have begun to increase the use of satellite imagery in reporting on world events. The media have generally supported the idea of a dedicated "mediasat" because it could supply a stream of timely and critical information, peering where repressive governments or dangerous natural environments have heretofore kept the press at bay. However, some U.S. policymakers believe that the media's use of this potentially intrusive technology could create national security problems and complicate U.S. foreign relations.

As the media's use of such images increases, conflicts are certain to arise between the media's first amendment rights and certain U.S. national security and foreign policy interests. OTA concludes that such conflicts are ultimately manageable, but that the existence of foreign remote sensing systems (which can only be indirectly affected by U.S. laws) may require some international consultation.

BACKGROUND PAPERS

Children's Mental Health: Problems and Services

OTA notes that a number of national studies and commissions have highlighted the need for improved children's mental health services. To meet this need changes may be necessary in the way mental health services are conceptualized, financed, and provided. One change might be to provide increased access to treatment on an outpatient basis before a child develops a diagnosable disorder. Also, reducing restrictions on mental health benefits could ease access to treatment.

In the background paper, OTA examines the extent to which the mental health field has reached a consensus on the apropriate treatments and treatment settings for responding to the mental health needs of our Nation's children. It looks into the nature of children's mental health problems, the services available to help them, and the Federal role in providing services.

New Developments in Biotechnology: Public Perceptions of Biotechnology

In this background paper, OTA reports the results of a nationwide survey of public knowledge and opinion about issues concerning science and technology in general and genetic engineering and biotechnology in particular. This background paper is the second in a series of OTA studies being carried out under an assessment of "New Developments in Biotechnology."

Technologies for the Preservation of Prehistoric and Historic Landscapes

In recent years, the American public and Congress have become much more aware of the value of historic landscapes as teachers and guides to America's heritage. Interest in preserving landscapes for the enjoyment and education of future generations extends well beyond saving historic battlefields and the grounds of historic houses. To date, no one has inventoried the many gardens, parks, and other historic landscapes designed by the well-known firms of Frederick Law Olmsted and his associates. The desire to rectify this situation has led to congressional consideration of a specific bill, the Olmsted Heritage Landscapes Act of 1987, which is discussed and analyzed in this background paper.

Because landscapes are always living, growing, and dying, they are highly vulnerable to environmental changes, from both human and natural agents. This background paper illustrates the importance of continuing to apply certain high leverage, cost-effective technologies, such as remote sensing and computer hardware and software, if this Nation wishes to protect, restore, and preserve important parts of its rich heritage for future generations of Americans.

Technologies for Underwater Archaeology and Maritime Preservation

This background paper describes and assesses the role of technology in underwater archaeology and historic maritime preservation. It also examines the legal framework that affects the salvage of historic shipwrecks and recovery of artifacts. State laws governing historic shipwrecks found in State coastal waters often conflict with Federal Admiralty law, which gives private salvors the right to salvage shipwrecks, regardless of their age or historic value. Attempts to place historic shipwrecks under the same protection as other historic cultural resources have led to the Historic Shipwreck Act of 1987, which is discussed and analyzed in this background paper.

Science, Technology, and the Constitution

Science and technology have, throughout our history, been major factors in shaping American society and our way of life. As we enter our third century of constitutional history, several areas of technology are undergoing rapid development and promise to have especially profound effects; microelectronics, biology, and chemistry, for example, are transforming the practice of medicine, criminal justice, newsgathering, and other social activities and institutions. This background paper summarizes and discusses major themes that are being explored in the project on *Science, Technology, and the Constitution*.

CASE STUDY

Nurse Practitioners, Physician Assistants, and Certified Nurse-Midwives: A Policy Analysis

The central questions the case study attempts to answer are:

- What contributions do NPs, PAs, and CNMs make in meeting the Nation's health-care needs?
- How would changing the method of payment for the services of NPs, PAs, and CNMs affect the roles these practitioners would play in the evolving health-care delivery system?
- How would changing the payment method affect health-care costs for patients, third-party payers, and society?

Section III.—Work in Progress

More than 56 projects were in progress during fiscal year 1987, which included 16 new studies.

This section lists the titles of assessments underway or in press, as of September 30, 1987. For a full description of these projects, please refer to the current "Assessment Activities," OTA-PC-105. This pamphlet may be obtained from OTA by calling OTA's Publication Request Line (202) 224-8996.

Energy, Materials, and International Security Division

Technology and the American economic transition

Energy and Materials Program
- Advanced materials by design
- Starpower: the U.S. and the international quest for fusion energy
- Competitiveness of domestic copper
- Technological risks and opportunities for future U.S. energy supply and demand
- Increased competition in the electric power industry
- High-temperature superconductors: research, development, and applications
- Oil production technologies and the Arctic National Wildlife Refuge

Industry, Technology, and Employment Program
- Technology, innovation, and U.S. trade
- Superfund implementation
- High-temperature superconductors: commercialization

International Security and Commerce Program
- SDI: technology, survivability and software
- Seismic verification of nuclear test ban treaties
- Advanced space transportation technologies
- Maintaining the defense technology base

Health and Life Sciences Division

Biological Applications Program
- New developments in biotechnology
- Infertility: medical & social choices
- Mapping our genes
- Methods for locating and arranging health and long-term care for persons with dementia

Food and Renewable Resources Program
- African agriculture: on being resourceful with few resources
- Technology and public policy to enhance grain quality in international trade
- Grassroots development: the African Development Foundation

Health Program
- Monitoring of mandated Vietnam veterans studies (mandated study)
- Healthy children: investing in the future
- Unorthodox cancer treatment
- The quality of medical care: information for consumers
- Diagnostic medical tests: impact on public and private policies toward health care

Drug labeling in developing countries—phase I
Federal response to AIDS: congressional issues

Science, Information, and Natural Resources Division

Communication and Information Technologies Program

- Technology, public policy, and the changing nature of Federal information dissemination
- Communications systems for an information age
- Science, technology, and the constitution in the information age
- VA hospital information systems
- Copyright and audio taping

Oceans and Environment Program

- New Clean Air Act issues
- Book preservation technologies

Science, Education, and Transportation Program

- Sustaining the national technological base: education and employment of scientists and engineers
- Educational technology: an assessment of practice and potential
- Safety in the commercial aviation and motor carrier industries

Section IV.—Organization and Operations

Created by the Technology Assessment Act of 1972 [86 Stat. 797], OTA is an agency of the legislative branch of the Federal Government (a copy of the Act is found in app. C, p. 132). OTA's primary function is to provide congressional committees with assessments or studies that identify the range of probable positive and negative consequences, social as well as physical, of policy alternatives affecting the uses of technology.

In providing assistance to Congress, OTA is to: identify existing or probable impacts of technology or technological programs; where possible, ascertain cause-and-effect relationships of the applications of technology; identify alternative technological methods of implementing specific actions; identify alternative programs for achieving requisite goals; estimate and compare the impacts of alternative methods and programs; present findings of completed analyses to the appropriate legislative authorities; identify areas where additional research or data collection is required to provide support for assessments; and undertake such additional associated activities as may be necessary.

The Act provides for a bipartisan congressional board, a director, and such other employees and consultants as may be necessary to conduct the Office's work. The congressional board is made up of six Senators, appointed by the President pro tempore of the Senate, and six Representatives, appointed by the Speaker of the House, evenly divided by party. In 1986, Sen. Ted Stevens (R-Alaska) and Cong. Morris Udall (D-Arizona) served as the Chairman and Vice Chairman, respectively, of the board. The two posts alternate between the Senate and House with each Congress. The board members from each Chamber select their respective officer.

The congressional board sets the policies of the Office and is the sole and exclusive body governing OTA. The board appoints the director, who is OTA's chief executive officer and a nonvoting member of the board.

The Act also calls for a Technology Assessment Advisory Council composed of 10 public members eminent in scientific and technological fields, the Comptroller General of the United States, and the Director of the Congressional Research Service of the Library of Congress. The advisory council advises the board and the director on such matters as the balance, comprehensiveness, and quality of OTA's work, and OTA's nongovernmental resources.

Requests for OTA assessments may be initiated by:

- the chairman of any standing, special, select, or joint committee of Congress, acting alone, at the request of the ranking minority member, or at the request of a majority of the committee members;

- the OTA board; or
- the OTA Director, in consultation with the board.

The authorization of specific assessment projects and the allocation of funds for their performance are the responsibilities of the OTA Board.

The analytical work of the Office is organized into three divisions, each headed by an assistant director. They encompass assessments grouped in the areas of energy and materials; international security and commerce; industry, technology, and employment; biological applications; food and renewable resources; health; communication and information technologies; oceans and environment; and science, education, and transportation. (See chart detailing OTA's organizational structure.)

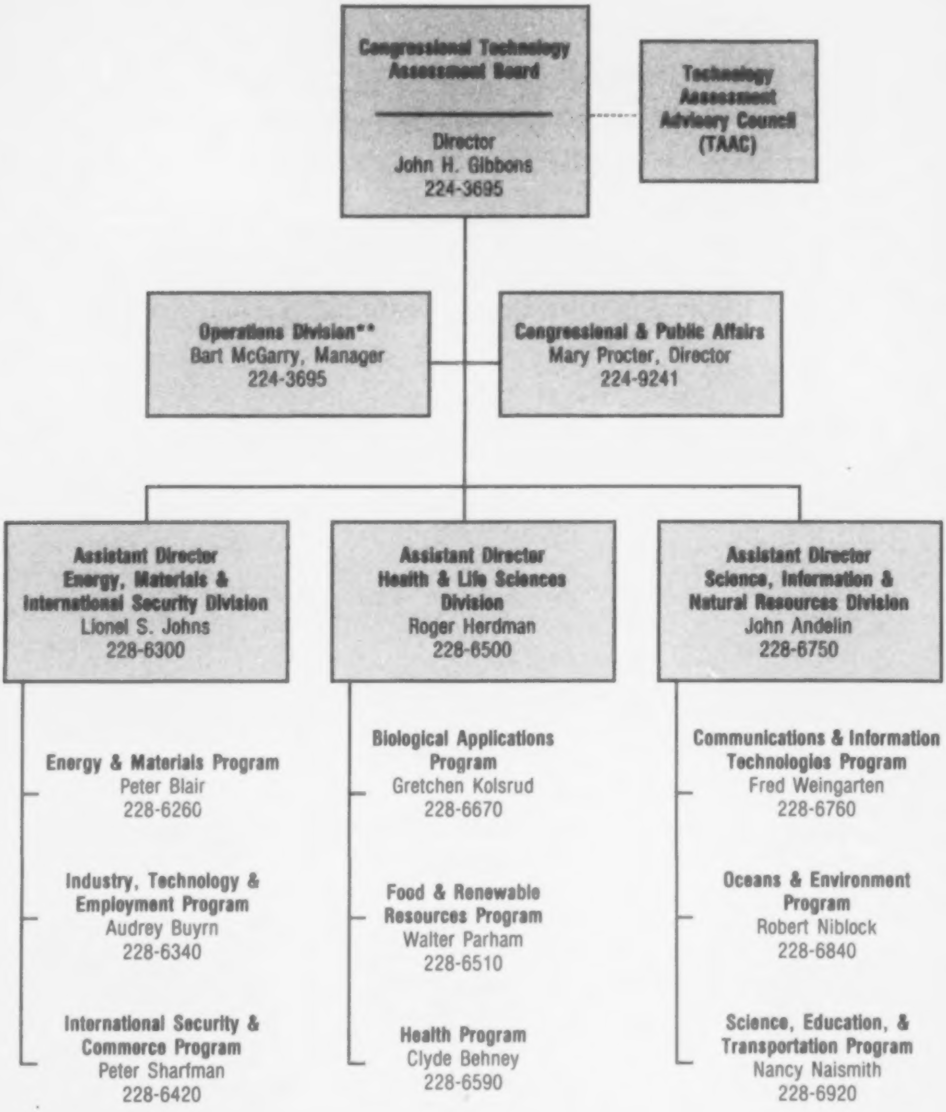
Staff of the Operations Division support the analytical work of the Office. These offices—Administrative Services, Contracts, Budget and Finance, Information Center, Personnel, Publishing, and Telecommunication and Information Services—provide the research staff and management with a variety of services and technologies vital to successful functioning of the Office. The Congressional and Public Affairs Office staff play a critical role in the Office by assisting in coordinating OTA's work with various committees of House and Senate, providing effective communications between OTA management and staff and the Technology Assessment Board and Technology Assessment Advisory Council, and by assuring wide dissemination of OTA's publications on Capitol Hill, as well as to the general public.

Staff professionals represent a wide range of disciplines and backgrounds, including the physical, biological, and environmental sciences, engineering, social sciences, law, and public administration. Professionals from executive branch agencies, detailed to OTA on a temporary basis, and participants in several congressional fellowship programs also contribute to the work of the Office.

The private sector is heavily involved in OTA studies as a source of expertise and perspectives. Contractors and consultants are drawn from industry, universities, private research organizations, and public interest groups.

OTA works to ensure that the views of the public are fairly reflected in its assessments. OTA involves the public in many ways—through advisory panels, workshops, and formal and informal public meetings. These interactions provide citizens with access to information and help OTA to remain sensitive to the full array of perspectives, not only of the recognized stakeholders, but also of technically trained and lay persons.

OTA* ORGANIZATION CHART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228-6750
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Peter Blair
228-6260
Industry, Technology & Employment Program
Audrey Buyrn
228-6340
International Security & Commerce Program
Peter Sharfman
228-6420
Biological Applications Program
Gretchen Kolsrud
228-6670
Food & Renewable Resources Program
Walter Parham
228-6510
Health Program
Clyde Behney
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Communications & Information Technologies Program
Fred Weingarten
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*Located at 600 Pennsylvania Ave., S.E., Washington, DC.
- Publication request line—224-8996.
- Personnel locator—224-8713.

**Operations Division consists of the following units: Administrative Services, Budget and Financial Operations, Information Center, Personnel Office, Publishing Office, and Telecommunications and Information Services.

Publishing Activities

During fiscal year 1986, OTA delivered 31 published documents to Congress. These included: 11 assessment reports, 3 technical memoranda, 6 background papers, 1 health technology case study, 6 special reports, and 4 administrative reports.

Requests for OTA Publications

During the period September 30, 1986 through October 1, 1987, OTA's Publishing Office received an average of 77 telephone and mail requests per day. Additional requests were processed by OTA program offices and the OTA Congressional and Public Affairs Office and are not included in the above statistics.

Private Sector Reprinting of OTA Publications

OTA publications are often selected by commercial publishers or private organizations for reprinting. Among the publications reprinted during the fiscal year were:

- Kreiger Publishing Co. (Melbourne, FL) reprinted:
  Ocean Incineration: Its Role in Managing Hazardous Waste
  Summary: Technologies and Management Strategies for Hazardous Waste Control
  Technologies for Prehistoric and Historic Preservation
  Transportation of Hazardous Materials
  Transportation of Hazardous Materials: State and Local Activities
- J.B. Lippincott Co. (Philadelphia, PA) reprinted:
  Blood Policy and Technology
  Life-Sustaining Technologies and the Elderly
  Losing a Million Minds: Confronting the Tragedy of Alzheimer's Disease and Other Dementias
  Ownership of Human Tissues and Cells
  Reproductive Health Hazards in the Workplace
  Technologies for Detecting Heritable Mutations in Human Beings
  Technologies To Maintain Biological Diversity
  Technology-Dependent Children: Hospital v. Home Care
  Wastes in Marine Environments
- Duke University Press (Durham, NC) reprinted:
  Children's Mental Health: Problems and Services
- North Carolina Biotechnology Center (Research Triangle Park, NC) reprinted:
  Commercial Biotechnology: An International Analysis
- Kern & Kollegen (Frankfurt, West Germany) translated and reprinted:
  Anti-Satellite Weapons, Countermeasures, and Arms Control Ballistic Missile Defense Technology

Sales of Publications

Government Printing Office.—Sales of OTA publications by the Superintendent of Documents continue to increase. In fiscal year 1987, the cumulative number of titles on sale was 228 and GPO has sold a total of 38,070 copies of OTA's reports.

National Technical Information Service.—NTIS sells scientific reports and papers that are, generally, not in great demand but are useful for scientific researchers. NTIS is the outlet for OTA's assessment working papers and contractor reports, plus those reports that are out of print by GPO. During fiscal year 1987, NTIS sold 1,172 copies of OTA documents.

Organization Roster of OTA Staff as of September 1987

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Glenda Lawing, *Secretary*
Barbara Murphy, *Administrative Assistant*

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Jean McDonald, *Press Officer*
Ellen Mika, *Assistant Press Officer*
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Rose McNair, *Resident Nurse*

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Thomas P. McGurn, *Administrative Officer*
Alexandra Ferguson, *Director of Contracts*
Claude Bowen, *Deputy Director of Contracts*

Budget and Finance Office

Catherine Singleton, *Budget and Finance Officer*
Carolyn Datcher, *Accounting Technician*
Carolyn Harris, *Budget Assistant*
Frances Hemingway, *Assistant Budget and Finance Officer*
Phil Jackson, *Financial Systems Computer Analyst*
Carrie Miller, *Accounting Technician*

Information Center

Martha Dexter, *Manager, Information Services*
Suzanne Boisclair, *Information Technician*
Leslie Fleming, *Information Technician*
Kathleen Flynn, *Information Technician*
Gail Kouril, *Assistant Manager, Information Services*

Personnel Office

William Norris, *Personnel Officer*
Lola Craw, *Personnel Specialist*
Denise DeSanctis, *Personnel Specialist*
Elizabeth Millis, *Administrative Assistant*

Publishing Office

Kathie S. Boss, *Publishing Officer*
John Bergling, *Graphic Designer/Illustrator*
Debra Datcher, *Publishing Specialist*

Telecommunications and Information Services

John Bell, *Senior Systems Integration Analyst*
Larry Bond, *Systems Analyst*
Brenda Miller, *Software Systems Specialist*

Appendixes

Appendix A
Technology Assessment Advisory Council

The Technology Assessment Advisory Council (TAAC) was established by OTA's statute, and members are appointed by OTA's Congressional Technology Assessment Board (TAB). The Council advises TAB and the Director on issues and other matters related to science, technology, and technology assessment.

Members of TAAC on September 30, 1987, were:

William J. Perry, *Chairman*: Dr. Perry is managing partner of H&Q Technology Partners. In 1985 he was a managing director in the investment banking firm of Hambrecht & Quist, Inc. Prior to joining H&Q, he was the U.S. Under Secretary of Defense for Research and Engineering. He is a member of the National Academy of Engineering.

David S. Potter, *Vice Chairman*: Dr. Potter retired as Vice President, Power Products and Defense Operations Group at General Motors in June 1985. He was formerly Assistant Secretary of the Navy for Research and Development and Under Secretary of the Navy. He is a member of the National Academy of Engineering.

Earl Beistline: Dr. Beistline is a private consultant in Fairbanks, Alaska. He is former Dean of the School of Mineral Industry, and also Former Provost of the University of Alaska.

Claire T. Dedrick*: Dr. Dedrick is Executive Officer of the State Land Commission of California. She is a former member of the State of California Air Resources Board, a former California Public Utilities Commissioner, and has served as Secretary for Resources with The Resources Agency of the State of California.

S. David Freeman: Mr. Freeman is the General Manager of the Lower Colorado River Authority. He is former Chairman and member of the Board of the Tennessee Valley Authority. He has headed the energy policy staff of the President's Office of Science and Technology Policy; directed the Ford Foundation Energy Policy Project; and served as assistant to the Chairman of the Federal Power Commission.

Michel T. Halbouty: Mr. Halbouty is Chairman of the Board of Michel T. Halbouty Energy Co. in Houston, Texas. Prior to establishing his company, he was a chief geologist and petroleum engineer with Glenn H. McCarthy and also with Yount-Lee Oil Co.

Carl N. Hodges*: Professor Hodges is Director of the University of Arizona Environmental Research Laboratory and Chairman of the Arizona Solar Energy Commission. He currently serves as a member of the National Academy of Sciences' Advisory Committee on Technology Innovation and as a member of the Arizona-Mexico Commission. Professor Hodges is a Fellow of the American Association for the Advancement of Science.

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*Term ended January 1988.

Rachel McCulloch*: Dr. McCulloch is Associate Professor of Economics at the University of Wisconsin, on leave in 1985 at the Hoover Institution at Stanford University. She has served as a consultant to the Federal Reserve Board; is a former member of the U.S. Cabinet Task Force on Oil Import Control; and served as a member of the Presidential Commission on Industrial Competitiveness.

Chase N. Peterson: Dr. Peterson is President of the University of Utah. He practiced medicine at the Salt Lake Clinic and taught at the LDS Hospital and University of Utah Medical School until his appointment as Dean of Admissions and Financial Aids at Harvard College. There he also served as Vice President for Alumni Affairs and Development. Dr. Peterson returned to the University of Utah in 1978 as Vice President for Health Sciences, and has served as University President since 1983.

Statutory Members

Charles A. Bowsher: Mr. Bowsher is Comptroller General of the United States and Director of the U.S. General Accounting Office.

Joseph E. Ross: Mr. Ross is Director of the Congressional Research Service, U.S. Library of Congress.

Newly Elected Members**

James C. Hunt: Dr. Hunt is the chancellor of the University of Tennessee Health Science Center in Memphis. He previously served as the Dean of Medicine for the University and as Chairman of the Department of Medicine at the Mayo Clinic.

Sally Ride: Dr. Ride is currently a fellow at the Stanford University Center for International Security and Arms Control. She is a former astronaut, and served as a member of the Presidential Commission on the Space Shuttle.

Joshua Lederberg: Dr. Lederberg is the President of Rockefeller University. He is the former Chairman of the Department of Genetics at Stanford University School of Medicine. He is a Member of the National Academy of Sciences and is a Nobel Laureate in Physiology and Medicine.

Dr. Neil Harl: Dr. Harl is the Charles F. Curtiss Distinguished Professor of Economics at Iowa State University, where he has served on the faculty since 1964.

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*Term ended January 1988.

**Elected October 1987, 4-year term began February 1988.

Appendix B
List of Advisors and Panel Members*

ENERGY, MATERIALS, AND INTERNATION SECURITY DIVISION

Energy and Materials Program

Competitiveness of the Domestic Copper Industry Advisory Panel

George S. Ansell, *Chair*
President
Colorado School of Mines

Richard Ayres
Senion Staff Attorney
Natural Resources Defense Council

Corale L. Brierley
President
Advanced Mineral Technologies, Inc.

Erling Brostuen
Secretary
State of Mexico
Department of Energy and Minerals

Henry Cole
Science and Policy Director
Clean Water Action Project

William Davenport
Professor
Department of Mining and Geological Engineering
University of Arizona

Robert Dimock
Vice President, Technology
Kennecott Copper Corp.

William H. Dresher
President
International Copper Research Association

John A. Hansen
Professor
Department of Economics
SUNY—Fredonia

James G. Hascall
President
Olin Brass

John Kelly
General Motors Corp.

Robert H. Lesemann
President
CRU Consultants Inc.

Larry G. Lewallen
President
AT&T Nassau Metals

Robert J. Muth
Senior Vice President
ASARCO, Inc.

William G. Pariseau
Professor
Department of Mining Engineering
University of Utah

Ted Reed
Director, Research Department
International Union of Operating Engineers

Michael Rieber
Professor
Department of Mining and Geological Engineering
College of Mines, University of Arizona

Thomas D. Schlabach
Department Head
AT&T Bell Laboratories

Jack E. Thompson
Consultant

Milton Wadsworth
Dean
School of Mines
University of Utah

Russell L. Wood
President
Copper Range Co.

---

*Affiliations are at time of appointment to panel or workshop.

Increased Competition in the Electric Power Industry Advisory Panel

Richard Schuler, *Chair*
Professor
School of Civil and Environmental Engineering
Cornell University

Howard Allen
Chairman
Southern California Edison Co.

John Anderson
Executive Director
Electricity Consumers Resource Council

William W. Berry
Chairman
Dominion Resources, Inc.

Jan Beyea
Senior Staff Scientist
National Audubon Society

Bill Carnahan
Public Utilities Director
City of Riverside

Will Comtois
Manager, Utility Planning
Westinghouse Electric Corp.

Mark Cooper
Energy Director
Consumer Federation of America

Floyd Culler
President
Electric Power Research Institute

Charles E. Curtis
Partner
Van Ness, Feldman, Sutcliffe, & Curtis

Richard Disbrow
President
American Electric Power Service Corp.

Jerry D. Geist
Chairman and President
Public Service Co. of New Mexico

Michael R. Gent
President
North American Electric Reliability Council

Janice G. Hamrin
Executive Director
Independent Energy Producers of California

Samuel Huntington
President and Chief Executive Officer
New England Electric System

Leonard Hyman
Vice President
Merrill Lynch Capital Markets

David Mohre
Director
Cajun Electric Power Cooperative, Inc.

Roger Naill
Vice President
Applied Energy Services

Gail Garfield Schwartz
Deputy Chairman
New York State Public Service Commission

Fred Schweppe
Professor
Electrical Engineering Department
Massachusetts Institute of Technology

Andrew Varley
Chairman
Iowa Utilities Board

Lee White
Partner
White, Fine, & Verville

Gene Zeltmann
Manager
Market Support and Program Development Operations
General Electric Co.

Workshop: Alternative Scenarios for Increased Competition in the Electric Power Industry

John Anderson
Executive Director
Electricity Consumers Resource Council

Jan Beyea
Senior Staff Scientist
National Audubon Society

Douglas Bohi
Director
Office of Economic Policy
Federal Energy Regulatory Commission

Ashley Brown
Commissioner
Public Utilities Commission of Ohio

Mark Cooper
Energy Director
Consumer Federation of America

Charles E. Curtis
Partner
Van Ness, Feldman, Sutcliffe, & Curtis

Richard Disbrow
President
American Electric Power Service Corp.

Janice G. Hamrin
Executive Director
Independent Energy Producers of California

Steve Herod
Director, Office of Coal and Electricity Policy
U.S. Department of Energy

Larry Hobart
Executive Director
American Public Power Association

Leonard Hyman
Vice President
Merrill Lynch Capital Markets

Gerald M. Keenan
Vice President and Treasurer
Palmer Bellevue Corp.

Kevin Kelly
Associate Director
National Regulatory Research Institute

Hyde Merrill
Power Technologies, Inc.

Everard Munsey
Vice President, Public Policy
Dominion Resources, Inc.

Joellyn K. Murphy
Vice President, Regulatory & Business Policy
Public Service Co. of New Mexico

Joe Pace
Senior Vice President
National Economic Research Associates

Jerry Pfeffer
Pfeffer, Lindsay & Associates

Richard Schuler
Professor
School of Civil and Environmental Engineering
Cornell University

Fred Schweppe
Professor
Electrical Engineering Department
Massachusetts Institute of Technology

Ian Straughan
Director of Research and Development
Southern California Edison Co.

Andrew Varley
Chairman
Iowa Utilities Board

William Walbridge
Executive Vice President and General Manager
Seminole Electric Cooperative

John P. Weyant
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Energy Modeling Forum
Stanford University

Oliver S. Yu
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Planning and Evaluation Division
Electric Power Research Institute

Gene Zeltmann
Manager
Market Support and Program Development Operations
General Electric Co.

Magnetic Fusion and Research Development Advisory Panel

William Carey, *Chair*
Executive Officer
American Association for the Advancement of Science

Ellen Berman
Executive Director
Consumer Energy Council of America

Linda Cohen
Assistant Visiting Professor of Economics
Department of Economics
University of Washington

Paul Craig
Professor of Physics
Department of Applied Science
University of California, Davis

Harold Forsen
Division Manager
Research and Development Division
Bechtel National, Inc.

T. Kenneth Fowler
Associate Director
Magnetic Fusion Energy
Lawrence Livermore National Laboratory

Melvin Gottlieb
Director Emeritus
Princeton Plasma Physics Laboratory

L. Charles Hebel
Manager, Research Planning
Corporate Research Technical Staff
Xerox Corp.

Robert Hirsch
Vice President Exploration & Production Research
Arco Oil & Gas Co.

Leonard Hyman
Vice President
Merrill Lynch Capital Markets

Betty Jensen
Research and Development
Public Service Electric & Gas Co.

Hans Landsberg
Senior Fellow Emeritus
Resources for the Future

Lawrence Lidsky
Professor of Nuclear Engineering
Massachusetts Institute of Technology

Irving Mintzer
Senior Associate
World Resources Institute

Robert Park
Executive Director
Office of Public Affairs
American Physical Society

Murray Rosenthal
Associate Lab Director for Advanced Energy Systems
Oak Ridge National Laboratory

Eugene Skolinikoff
Director
Center for International Studies
Massachusetts Institute of Technology

Herbert Woodson
Director
Center for Energy Studies
University of Texas, Austin

Workshop: International Cooperation in Magnetic Fusion Research and Development

Richard Barnes
Director, International Affairs Division
National Aeronautics and Space Administration

Harold Benglesdorf
International Energy Associates Ltd.

Diana Bieliauskas
National Academy of Sciences

Justin Bloom
President
Technology International, Inc.

Judy Bostock
Office of Management and Budget

Melvin Gottlieb
Director Emeritus
Princeton Plasma Physics Laboratory

Paul Huray
Senior Policy Analyst
Office of Science and Technology Policy

Paul Josephson
Program in Science, Technology and Society
Massachusetts Institute of Technology

Wilfrid Kohl
Director, International Energy Program
School of Advanced International Studies
The Johns Hopkins University

Linda Lubrano
Professor
School of International Services
The American University

Leonard Lynn
Professor
Department of Social and Decision Sciences
Carnegie-Mellon University

Charles Newstead
U.S. Department of State

Herman Pollack
Professor
Graduate Program in Science, Technology, and Public Policy
George Washington University

Michael Roberts
Director, International Programs
Office of Fusion Energy
U.S. Department of Energy

Richard Samuels
Associate Professor of Political Science
Massachusetts Institute of Technology

Eugene Skolnikoff
Director, Center for International Studies
Massachusetts Institute of Technology

Robert W. Turner
ODUSD—TSP
Pentagon

Workshop: Energy Context

Robert Fri, *Chair*
President
Resources for the Future

Truman Anderson
Director, Program Planning and Analysis
Oak Ridge National Laboratory

Charles Backus
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Arizona State University

Charles Berg
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Department of Mechanical Engineering
Northeastern University

Jan Beyea
Vice President of Science
National Audubon Society

Paul Craig
Professor of Physics
Department of Applied Science
University of California, Davis

Daniel Dreyfus
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Gas Research Institute

James A. Edmonds
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Columbia University

Mark Mills
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Irving Mintzer
Senior Associate
World Resources Institute

Carlo La Porta
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Solar Energy Industries Association

Eric Reichl
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Arthur Rosenfeld
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John R. Siegel
Vice President
Atomic Industrial Forum

Don Steiner
Professor
Department of Nuclear Engineering
Rensselaer Polytechnic Institute

New Structural Materials Technologies Advisory Panel

Rodney W. Nichols, *Chair*
Executive Vice President
The Rockefeller University

J. Michael Bowman
Director, Composites Venture
E.I. du Pont de Nemours & Co.

Robert Buffenbarger
Chairman, Bargaining Committee
G.E. Aircraft Engine Group
International Association of Machinists

Joel Clark
Associate Professor of Materials Systems
Director of Materials Systems Laboratory
Massachusetts Institute of Technology

James Cornie
Principal Research Scientist
Department of Materials Processing Center
Massachusetts Institute of Technology

Laimonis Embrekts
Consultant
Dix Hills, NY

Samuel Goldberg
President
INCO-US Inc.

Sheldon Lambert
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Plano, TX

James W. Mar
Director, Technology Laboratories for Advanced Composites
Department of Aeronautics and Astronautics
Massachusetts Institute of Technology

Arthur F. McLean
Manager, Ceramics Research
Scientific Research Laboratory
Ford Motor Co.

Joseph Panzarino
Director, Research and Development of High Performance Ceramics
Norton Co.

Dennis W. Readey
Chairman
Ceramics Engineering Department
Ohio State University

B. Walter Rosen
President
Materials Sciences Corp.

Amy L. Walton
Member, Technical Staff
Jet Propulsion Laboratory

Alvin S. Weinstein
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Dick Wilkins
Director, Center for Composite Materials
University of Delaware

Workshop: Collaborative R&D Arrangements in Advanced Materials and Other High-Technology Fields

Amy L. Walton, *Chair*
Program Manager
Jet Propulsion Laboratory

Michael G. Bolton
Executive Director
Ben Franklin Advanced Technology Center
Lehigh University

Ed Cohen
Executive Director
New Jersey Science and Technology Commission

Dan Dimancescu
Partner
Technology and Strategies Group

Henry Etzkowitz
Professor
Department of Sociology at SUNY
Center for Science and Technology Policy

Robert M. Fisher
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Sarah Shauf Friel
Manager of Technology Administration
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Robert E. Gee
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Steven Hsu
Chief, Ceramics Division
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Bernard H. Kear
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College of Engineering
Rutgers University

Don Kinosz
Manager, Ceramics Division
Alcoa Laboratories

Ronald Latanision
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Materials Processing Center
Massachusetts Institute of Technology

Samuel Thomas Picraux
Manager, Ion Implantation and Microsensor Research Department
Sandia National Laboratory

Thomas Rhyne
Director, VLSI/CAD Program
Microelectronics & Computer Technology Corp.

Dwight A. Sangrey
Dean, School of Engineering
Rensselaer Polytechnic Institute

Warren D. Siemens
Director, Technology Applications
Martin Marietta Energy Systems

Workshop: Advanced Materials Industries

Dick Wilkins, *Chair*
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Center for Composite Materials
University of Delaware

Stanley Abkowitz
President
Dynamet Technologies, Inc.

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Engineering Materials Sector
Allied Signal Corp.

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Technical Advisor
Resins Business Center
Shell Chemical Co.

James N. Burns
V.P. Graphite Materials & Aircraft Structures
Hercules, Inc.

David Cammerota
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Walter F. Cebulak
Manager of Government Technology
Alcoa Technical Center

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Grumman Aircraft Systems

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DWA Composite Specialists, Inc.

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Department of Engineering & Public Policy
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Wayne Godwin
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BASF

A. Seth Greenwald
Director, Orthopedic Research
Mount Sinai Medical Center

Michael T. Kelley
Deputy Assistant Secretary for Basic Industries
U.S. Department of Commerce

Robert Manildi
Manager, Advanced Composites
Hexcel Corp.

James Manion
Industry Specialist
U.S. Department of Commerce

Paul Pendorf
Vice President, ICI Advanced Materials
Fiberite Corp.

Mike B. Powell
Market Development Manager
Union Carbide Corp.

Randolph B. Robinson
Manager, Technical Engineer & FAA Liaison
Beech Aircraft

Bob Russell
Divisional Vice President
Norton Co. High Performance Ceramic

John Scanlon
Chief, Concrete Technology Division
U.S. Army Corps of Engineers
Waterways Experimental Station

Moira Shea
Industry Specialist
U.S. Department of Commerce

Nicholas Spencer
National Sales Manager
Composite Materials Department
Ciba-Geigy Corp.

David Wirth
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Coors Porcelain Co.

Technological Risks and Opportunities for Future U.S. Energy Supply and Demand Advisory Panel

John Sampson Toll, *Chair*
President
University of Maryland, College Park

Charles A. Berg
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Department of Mechanical Engineering
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ARCO Solar, Inc.

Daniel A. Dreyfus
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David R. Johns
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David Lee Kulp
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Ford Motor Co.

Jessica Mathews
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Edward H. Mergens
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Shell Oil Co.

Nathan Rosenberg
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Department of Economics
Stanford University

Edwin Rothschild
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Citizen/Labor Energy Coalition

Milton Russell
Professor of Economics
University of Tennessee and Oak Ridge National Laboratory

Maxine Savitz
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Ceramic Components Division
Garrett Engineering Corp.

Robert Wallace
Senior Vice President, Corporate Planning
Peabody Holding Co.

Jack W. Wilkinson
Chief Economist
Sun Co., Inc.

Robert Williams
Professor
Center for Energy and Environmental Studies
Princeton University

Mason Willrich
Senior Vice President
Corporate Planning and Information Systems
Pacific Gas & Electric Co.

Industry, Technology, and Employment Program

International Competition in the Service Industries Advisory Panel

Robert Gilpin, *Chair*
Woodrow Wilson School of Public and International Affairs
Princeton University

C. Michael Aho
Director of Economics Studies and International Trade Project
Council on Foreign Relations, Inc.

Mark Anderson
Economist
Department of Economic Research
AFL-CIO

John Bowles
President
Public Policy Analysis, Inc.

Robert B. Cohen
Special Consultant on High Technology Economic Development Programs
New York State Urban Development Corp.

Richard L. Crandall
President and CEO
Comshare

Ronnie L. Goldberg
Vice President
International Business
New York Chamber of Commerce and Industry

George Kohl
Research Economist
Development and Research Department
Communications Workers of America

Stephen D. Krasner
Professor
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Stanford University

Robert Kuttner
Economics Writer

Martin Mayer
Author

William Nolen
Attorney-At-Law, CPA
Whitmore, Sheppard, & Pollicoff

Hugh O'Donnell
Senior Vice President
Crocker National Bank

K. Nagaraja Rao
Vice President for Research
Wentworth Institute of Technology

Cathy A. Schoen
Research Director
Service Employees International Union

Jeffrey J. Schott
Visiting Fellow
Institute for International Economics

Ronald K. Shelp
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Celanese Corp.

Superfund Implementation Advisory Panel

David Marks, *Chair*
Professor
Civil Engineering
Massachusetts Institute of Technology

Michael Belliveau
Research Director
Citizens for a Better Environment

Kirk Brown
Head, Soil and Crop Sciences Department
Soil Physics Section
Texas A&M University

Richard Brownell
Vice President
Malcolm Pirnie, Inc.

William Child
Manager
Division of Land Pollution Control
Illinois Environmental Protection Agency

E. William Coglazier
Director
Waste Management Institute
University of Tennessee

Henry Cole
Science and Policy Director
Clean Water Action Project and
National Campaign Against Toxic Hazards

William B. DeVille
Administrator, Inactive and Abandoned Sites Division
Louisiana Department of
Environmental Quality

Deborah Hankins
Manager, Remedial Issues
Corporate Environmental Programs
General Electric Corp.

Bob Harris
Principal
ENVIRON Corp.

William N. Hedeman
Esquire
Beveridge & Diamond, P.C.

Robert G. Kissell
Senior Consultant
Engineering Service Division
E.I. du Pont de Nemours & Co., Inc.

Steve Lester
Science Director
Citizens Clearinghouse for Hazardous Waste

William Librizzi
Deputy Assistant Commissioner of Hazardous Waste Management
New Jersey Department of
Environmental Protection

George Muhlebach
Director, Environmental Protection
Ciba-Geigy Corp.

Robert N. Ogg
Environmental Engineer
CH2M Hill

Robert B. Pojasek
President
ChemCycle Corp.

Frank J. Veale, Jr.
Manager, Environmental Engineering
Materials & Controls Group
Texas Instruments, Inc.

James N. Walsh
Executive Director
Thermal Kinetics

Technology, Innovation & U.S. Trade Advisory Panel

Lewis Branscomb, *Chairman*
Director
Science, Technology, and Public Policy Project
Kennedy School of Government

C. Michael Aho
Director of Economics Studies and International Trade Project
Council on Foreign Relations, Inc.

John M. Culbertson
Professor of Economics
University of Wisconsin, Madison

Bruce Cumings
Professor
University of New York

Joseph Grunwald
President
Institute of the Americas
University of California, San Diego

Thomas Hout
Vice President
Boston Consulting Group

Franklin P. Johnson, Jr.
General Partner
Asset Management Co.

Lester C. Krogh
Vice President for Research and Development
Minnesota Mining and Manufacturing

Paul R. Krugman
Professor of Economics
Bureau of Economic Research
Massachusetts Institute of Technology

Alvin P. Lehnerd
Vice President
Steelcase, Inc.

Ann Markusen
Professor, Center for Urban Affairs & Policy Research
Northwestern University

Ray Marshall
Rapoport Chair
Economics and Public Affairs
University of Texas, Austin

Regis McKenna
Chairman
Regis McKenna, Inc.

Richard S. Morse
Director
Tracor Technology, Inc.

David Mowery
Director, Technology and
Unemployment Panel
National Academy of Sciences

Paula Stern
Senior Associate
Carnegie Endowment for International
Peace

Brian Turner
Executive Assistant to the President
Industrial Union Department
AFL-CIO

Gus Tyler
Assistant President
International Ladies Garment Workers
Union

Lewis C. Veraldi
Vice President
Car Programs Management
Ford Motor Co.

Ezra F. Vogel
Professor of International Affairs
Harvard University

International Security and Commerce Program

Advanced Space Transportation Technologies Advisory Panel

M. Granger Morgan, *Chair*
Head, Department of Engineering and
Public Policy
Carnegie-Mellon University

I.M. Bernstein
Provost and Academic Vice President
Illinois Institute of Technology

Michael A. Berta
Assistant Division Manager
Government Electronics Systems
Division
Space and Communications Group
Hughes Aircraft Co.

Richard E. Brackeen
President
Martin Marietta Commercial Titan,
Inc.

Edward T. Gerry
President
W.J. Schafer Associates, Inc.

Jerry Grey
Director, Science and Technology
Policy
American Institute of Aeronautics and
Astronautics

William H. Heiser
Vice President/Director
Aerojet Propulsion Research Institute

Otto W. Hoernig, Jr.
Vice President
Contel/American Satellite Corp.

Donald B. Jacobs
Vice President
Space Systems Division
Boeing Aerospace Co.

John Logsdon
Director
Graduate Program in Science,
Technology & Public Policy
George Washington University

Hugh F. Loweth
Consultant

Anthony J. Macina
Program Manager
Software Systems
IBM Federal Systems Division

George B. Merrick
Vice President, Engineering & Mission
Analysis
North American Space Operations
Rockwell International Corp.

Bruce Murray
Professor
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Alan Parker
Senior Vice President
Business Development
Technical Applications, Inc.

Gerard Piel
Chairman of the Board
Scientific American

Bryce Poe, II
General, USAF (retired)
Consultant

Ben R. Rich
Vice President and General Manager
Advanced Development Projects
Lockheed Corp.

Sally Ride
Professor
Center for International Security and Arms Control
Stanford University

Tom Rogers
President
The Sophron Foundation

Richard Smith
Consultant

William F.H. Zersen
Program Manager
Space Flight Systems
United Technologies Corp.

Workshop: Space Launch Management and Operations

Jerry Grey, *Chair*
Director, Science and Technology Policy
American Institute of Aeronautics and Astronautics

William Anders
Col., USAF
Headquarters Space Division
Air Force Systems Command

Stewart Baily
Manager
Government & Commercial Systems Division
ARINC Research Corp.

Hal Beck
Assistant Division Chief
Mission Planning and Analysis
Johnson Space Center

Aldo Bordano
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Alan Deluna
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Cort Durocher
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Advanced Launch System
Air Force Space Division, AFSC.

Douglas Heydon
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Arianespace, Inc.

James Hollopeter
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Space Systems Division
General Dynamics

Lyle Holloway
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McDonnell Douglas Astronautics Co.

Anthony J. Macina
Program Manager, Onboard Software Systems
IBM Federal Systems Division

Allan McCaskill
Manager, Launch Vehicle Program
INTELSAT

Douglas Morris
Aerospace Engineer
Space Systems Division
NASA Langley Research Center

Walter J. Overend
General Manager
Programs and Performance Engineering
Delta Airlines Engineering Department

J.D. Phillips
Director of Engineering Development
Kennedy Space Center

Defense Technology Base Advisory Panel

Walter B. Laberge, *Chair*
Vice President of Corporate Development
Lockheed Corp.

Michael R. Bonsignore
President
Honeywell International

William Carey
Consultant to the President
Carnegie Corp. of New York

Thomas E. Cooper
Vice President
Aerospace Technology
General Electric

John Deutch
Provost
Massachusetts Institute of Technology

Robert Fossum
Dean
School of Engineering and Applied Sciences
Southern Methodist University

Jacques Gansler
Senior Vice President
The Analytic Sciences Corp.

B.R. Inman
Admiral, USN (retired)
Chairman and Chief Executive Officer
Westmark Systems, Inc.

Paul Kaminski
President
H&Q Technology Partners, Inc.

Lawrence Korb
Dean, Graduate School of Public and International Affairs
University of Pittsburgh

George Kozmetsky
Executive Associate—Economic Affairs
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Workshop: Commercial Newsgathering From Space

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Executive Central Air Safety Chairman
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Appendix C
OTA Act

Public Law 92-484
92nd Congress, H. R. 10243
October 13, 1972

An Act

86 STAT. 797

To establish an Office of Technology Assessment for the Congress as an aid in the identification and consideration of existing and probable impacts of technological application; to amend the National Science Foundation Act of 1950; and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Technology Assessment Act of 1972".

Technology Assessment Act of 1972.

FINDINGS AND DECLARATION OF PURPOSE

SEC. 2. The Congress hereby finds and declares that:

(a) As technology continues to change and expand rapidly, its applications are—

(1) large and growing in scale; and

(2) increasingly extensive, pervasive, and critical in their impact, beneficial and adverse, on the natural and social environment.

(b) Therefore, it is essential that, to the fullest extent possible, the consequences of technological applications be anticipated, understood, and considered in determination of public policy on existing and emerging national problems.

(c) The Congress further finds that:

(1) the Federal agencies presently responsible directly to the Congress are not designed to provide the legislative branch with adequate and timely information, independently developed, relating to the potential impact of technological applications, and

(2) the present mechanisms of the Congress do not and are not designed to provide the legislative branch with such information.

(d) Accordingly, it is necessary for the Congress to—

(1) equip itself with new and effective means for securing competent, unbiased information concerning the physical, biological, economic, social, and political effects of such applications; and

(2) utilize this information, whenever appropriate, as one factor in the legislative assessment of matters pending before the Congress, particularly in those instances where the Federal Government may be called upon to consider support for, or management or regulation of, technological applications.

ESTABLISHMENT OF THE OFFICE OF TECHNOLOGY ASSESSMENT

SEC. 3. (a) In accordance with the findings and declaration of purpose in section 2, there is hereby created the Office of Technology Assessment (hereinafter referred to as the "Office") which shall be within and responsible to the legislative branch of the Government.

(b) The Office shall consist of a Technology Assessment Board (hereinafter referred to as the "Board") which shall formulate and promulgate the policies of the Office, and a Director who shall carry out such policies and administer the operations of the Office.

Technology Assessment Board.

(c) The basic function of the Office shall be to provide early indications of the probable beneficial and adverse impacts of the applications of technology and to develop other coordinate information which may assist the Congress. In carrying out such function, the Office shall:

Duties.

(1) identify existing or probable impacts of technology or technological programs;

(2) where possible, ascertain cause-and-effect relationships;

(3) identify alternative technological methods of implementing specific programs;

(4) identify alternative programs for achieving requisite goals;

(5) make estimates and comparisons of the impacts of alternative methods and programs;

(6) present findings of completed analyses to the appropriate legislative authorities;

(7) identify areas where additional research or data collection is required to provide adequate support for the assessments and estimates described in paragraph (1) through (5) of this subsection; and

(8) undertake such additional associated activities as the appropriate authorities specified under subsection (d) may direct.

(d) Assessment activities undertaken by the Office may be initiated upon the request of:

(1) the chairman of any standing, special, or select committee of either House of the Congress, or of any joint committee of the Congress, acting for himself or at the request of the ranking minority member or a majority of the committee members;

(2) the Board; or

(3) the Director, in consultation with the Board.

Information, availability.

(e) Assessments made by the Office, including information, surveys, studies, reports, and findings related thereto, shall be made available to the initiating committee or other appropriate committees of the Congress. In addition, any such information, surveys, studies, reports, and findings produced by the Office may be made available to the public except where—

(1) to do so would violate security statutes; or

(2) the Board considers it necessary or advisable to withhold such information in accordance with one or more of the numbered paragraphs in section 552(b) of title 5, United States Code. 81 Stat. 54.

TECHNOLOGY ASSESSMENT BOARD

Membership.

SEC. 4. (a) The Board shall consist of thirteen members as follows:

(1) six Members of the Senate, appointed by the President pro tempore of the Senate, three from the majority party and three from the minority party;

(2) six Members of the House of Representatives appointed by the Speaker of the House of Representatives, three from the majority party and three from the minority party; and

(3) the Director, who shall not be a voting member.

Vacancies.

(b) Vacancies in the membership of the Board shall not affect the power of the remaining members to execute the functions of the Board and shall be filled in the same manner as in the case of the original appointment.

Chairman and vice chairman.

(c) The Board shall select a chairman and a vice chairman from among its members at the beginning of each Congress. The vice chairman shall act in the place and stead of the chairman in the absence of the chairman. The chairmanship and the vice chairmanship shall alternate between the Senate and the House of Representatives with each Congress. The chairman during each even-numbered Congress shall be selected by the Members of the House of Representatives on the Board from among their number. The vice chairman during each

Duties.

(b) The Council, upon request by the Board, shall—

(1) review and make recommendations to the Board on activities undertaken by the Office or on the initiation thereof in accordance with section 3(d);

(2) review and make recommendations to the Board on the findings of any assessment made by or for the Office; and

(3) undertake such additional related tasks as the Board may direct.

Chairman and Vice Chairman.

(c) The Council, by majority vote, shall elect from its members appointed under subsection (a)(1) of this section a Chairman and a Vice Chairman, who shall serve for such time and under such conditions as the Council may prescribe. In the absence of the Chairman, or in the event of his incapacity, the Vice Chairman shall act as Chairman.

Term of office.

(d) The term of office of each member of the Council appointed under subsection (a)(1) shall be four years except that any such member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed shall be appointed for the remainder of such term. No person shall be appointed a member of the Council under subsection (a)(1) more than twice. Terms of the members appointed under subsection (a)(1) shall be staggered so as to establish a rotating membership according to such method as the Board may devise.

Travel expenses.

80 Stat. 498; 83 Stat. 190. 5 USC 5701.

(e)(1) The members of the Council other than those appointed under subsection (a)(1) shall receive no pay for their services as members of the Council, but shall be allowed necessary travel expenses (or, in the alternative, mileage for use of privately owned vehicles and a per diem in lieu of subsistence at not to exceed the rate prescribed in sections 5702 and 5704 of title 5, United States Code), and other necessary expenses incurred by them in the performance of duties vested in the Council, without regard to the provisions of subchapter 1 of chapter 57 and section 5731 of title 5, United States Code, and regulations promulgated thereunder.

Compensation.

(2) The members of the Council appointed under subsection (a)(1) shall receive compensation for each day engaged in the actual performance of duties vested in the Council at rates of pay not in excess of the daily equivalent of the highest rate of basic pay set forth in the General Schedule of section 5332(a) of title 5, United States Code, and in addition shall be reimbursed for travel, subsistence, and other necessary expenses in the manner provided for other members of the Council under paragraph (1) of this subsection.

UTILIZATION OF THE LIBRARY OF CONGRESS

SEC. 8. (a) To carry out the objectives of this Act, the Librarian of Congress is authorized to make available to the Office such services and assistance of the Congressional Research Service as may be appropriate and feasible.

(b) Such services and assistance made available to the Office shall include, but not be limited to, all of the services and assistance which the Congressional Research Service is otherwise authorized to provide to the Congress.

(c) Nothing in this section shall alter or modify any services or responsibilities, other than those performed for the Office, which the Congressional Research Service under law performs for or on behalf of the Congress. The Librarian is, however, authorized to establish within the Congressional Research Service such additional divisions, groups, or other organizational entities as may be necessary to carry out the purpose of this Act.

(d) Services and assistance made available to the Office by the Congressional Research Service in accordance with this section may be provided with or without reimbursement from funds of the Office, as agreed upon by the Board and the Librarian of Congress.

UTILIZATION OF THE GENERAL ACCOUNTING OFFICE

SEC. 9. (a) Financial and administrative services (including those related to budgeting, accounting, financial reporting, personnel, and procurement) and such other services as may be appropriate shall be provided the Office by the General Accounting Office.

(b) Such services and assistance to the Office shall include, but not be limited to, all of the services and assistance which the General Accounting Office is otherwise authorized to provide to the Congress.

(c) Nothing in this section shall alter or modify any services or responsibilities, other than those performed for the Office, which the General Accounting Office under law performs for or on behalf of the Congress.

(d) Services and assistance made available to the Office by the General Accounting Office in accordance with this section may be provided with or without reimbursement from funds of the Office, as agreed upon by the Board and the Comptroller General.

COORDINATION WITH THE NATIONAL SCIENCE FOUNDATION

SEC. 10. (a) The Office shall maintain a continuing liaison with the National Science Foundation with respect to—

(1) grants and contracts formulated or activated by the Foundation which are for purposes of technology assessment; and

(2) the promotion of coordination in areas of technology assessment, and the avoidance of unnecessary duplication or overlapping of research activities in the development of technology assessment techniques and programs.

Scientific programs, financing. 92 Stat. 360.

(b) Section 3(b) of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1862(b)), is amended to read as follows:

"(b) The Foundation is authorized to initiate and support specific scientific activities in connection with matters relating to international cooperation, national security, and the effects of scientific applications upon society by making contracts or other arrangements (including grants, loans, and other forms of assistance) for the conduct of such activities. When initiated or supported pursuant to requests made by any other Federal department or agency, including the Office of Technology Assessment, such activities shall be financed whenever feasible from funds transferred to the Foundation by the requesting official as provided in section 14(g), and any such activities shall be unclassified and shall be identified by the Foundation as being undertaken at the request of the appropriate official."

64 Stat. 156; 32 Stat. 365. 42 USC 1873.

ANNUAL REPORT

SEC. 11. The Office shall submit to the Congress an annual report which shall include, but not be limited to, an evaluation of technology assessment techniques and identification, insofar as may be feasible, of technological areas and programs requiring future analysis. Such report shall be submitted not later than March 15 of each year.

APPROPRIATIONS

SEC. 12. (a) To enable the Office to carry out its powers and duties, there is hereby authorized to be appropriated to the Office, out of any money in the Treasury not otherwise appropriated, not to exceed $5,000,000 in the aggregate for the two fiscal years ending June 30, 1973, and June 30, 1974, and thereafter such sums as may be necessary.

(b) Appropriations made pursuant to the authority provided in subsection (a) shall remain available for obligation, for expenditure, or for obligation and expenditure for such period or periods as may be specified in the Act making such appropriations.

Approved October 13, 1972.

LEGISLATIVE HISTORY:

HOUSE REPORTS: No. 92-469 (Comm. on Science and Astronautics) and
No. 92-1436 (Comm. of Conference).
SENATE REPORT No. 92-1123 (Comm. on Rules and Administration).
CONGRESSIONAL RECORD, Vol. 118 (1972):
Feb. 8, considered and passed House.
Sept.14, considered and passed Senate, amended.
Sept.22, Senate agreed to conference report.
Oct. 4, House agreed to conference report.

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